The University of Alberta
Printing Department
Edmonton, Alberta

UNIVERSITY OF ALBERTA
LIBRARY

Regulations Regarding Theses and Dissertations

Typescript copies of theses and dissertations for Master's and Doctor's degrees deposited in the University of Alberta Library, as the official Copy of the Faculty of Graduate Studies, may be consulted in the Reference Reading Room only.

A second copy is on deposit in the Department under whose supervision the work was done. Some Departments are willing to loan their copy to libraries, through the inter-library loan service of the University of Alberta Library.

These theses and dissertations are to be used only with due regard to the rights of the author. Written permission of the author and of the Department must be obtained through the University of Alberta Library when extended passages are copied. When permission has been granted, acknowledgement must appear in the published work.

This thesis or dissertation has been used in accordance with the above regulations by the persons listed below. The borrowing library is obligated to secure the signature of each user.

THE UNIVERSITY OF ALBERTA

CHILDREN'S UNDERSTANDING OF TIME DURATION

by

WARREN OSCAR NEWMAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF EDUCATION

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA

JULY 1967

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled, "Children's Understanding of Time Duration," submitted by Warren Oscar Newman in partial fulfilment of the requirements for the degree of Master of Education.

ACKNOWLEDGEMENTS

The writer expresses his gratitude to the chairman of the thesis committee, Dr. L. D. Nelson, whose suggestions, criticisms and encouragement were greatly appreciated.

Appreciation is also expressed to Dr. A. Kratzmann, Dr. G. R. Lefrançois and Mr. T. Aoki, members of the committee, for their interest and counsel.

The writer is indebted to Mr. Daiyo Sawada and Dr. V. R. Nyberg for their most helpful advice regarding the statistical analyses used in the study.

Grateful acknowledgement is made of the courtesy and cooperation extended to the writer by the Edmonton Public School Board and the principals of the schools in which the study was conducted.

ABSTRACT

The purpose of this study was to investigate the factors which influence the elementary school child's understanding of time duration and the stages by which such understanding is acquired.

A battery of three subtests, constructed by the investigator, was used to measure understanding of specific aspects of the concept of duration. These aspects were:

1. Understanding of verbal comparisons of duration.

2. Understanding of graphic comparisons of duration.

3. Ability to use measures of duration.

The tests were individually administered to a sample of one hundred and ninety-two elementary school children in grades one to six inclusive. This sample, made up of sixteen boys and sixteen girls from each grade level, ranged in age from approximately six years to thirteen years. All of the subjects were enrolled in schools within the Public School System of Edmonton, Alberta, Canada, when the testing program was conducted during April, 1967.

The relationships between the performance of the subjects on the three subtests and the factors of sex, socio-economic status, intelligence, chronological age and grade placement were sought by statistical analysis. In addition, the response patterns of the subjects in each grade were studied in an attempt to determine developmental stages in the understanding of the concept of duration.

The most important findings of this study were as follows:

1. Intelligence, chronological age and grade placement were all

significantly related to performance on the three subtests and on analysis, were found to be significant predictors of the child's ability to understand duration.

2. The correlation between socio-economic status and performance on the subtests was small but significant. Socio-economic status was found to be a significant predictor of ability to understand verbal comparisons and measures of duration but not graphic comparisons of duration.

3. Sex was not significantly related to the ability to understand duration.

4. Comparisons of duration were generally understood by children at the grade three level.

5. Measures of duration were first used satisfactorily by children at the grade four level.

6. Ability to use measures of duration appeared to be closely linked to ability to understand verbal comparisons of duration.

7. In grades one and two, the child's understanding of verbal comparisons of duration was more advanced than his understanding of graphic comparisons of duration. From grade three onwards, little difference in the understanding of either was observed.

8. A noticeable improvement in the ability to understand comparisons and measures of duration was observed at the grade six level.

Some implications for educational practice were presented, along with some suggestions for further research.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

THE PROBLEM, ITS NATURE AND SIGNIFICANCE

I. INTRODUCTION

Knowledge of the formation and development of children's concepts is of great importance to educators. Unless the extent of the child's concept mastery is known, it is extremely difficult to assess the type of information which he will be able to handle meaningfully and the rate at which he will be able to progress to new information. For these reasons, knowledge of the thought processes which children use and the stages by which these processes develop is essential to the development of meaningful courses of instruction and the selection of appropriate instructional techniques.

In all fields of the school curriculum, but particularly in the field of social studies, one of the most important concepts which the child must master is the concept of time. Without understanding of time the child is unable to make meaningful associations between events described to him and his own knowledge and experience of the world about him. If, for example, the child has no understanding of the period of time involved in a year, discussion of an event which occurred twenty years ago will have little meaning for him. He will simply view the event as having happened "a long time ago". Furthermore, without appreciation of the intervals of time between events, he will be unable to grasp the important notion of sequence which is so vital to effective evaluation of the contribution of past events to our current way of life.

As a logical concept, time has two aspects - order and duration. Order involves sequence of events and is embodied in such expressions as "before", "after" and "at the same time". It is this aspect of time which forms the basis of our notion of chronological order. Duration involves the intervals of time which separate events and may be expressed either as comparisons, such as "less time than", "more time than" and "the same time as", or in general or specific measures. General measures of duration include such terms as "not long" and "a long time", while specific measures involve the use of conventional time units such as "eight hours", "twelve days" and "five years".

Considerable research has been carried out over the last forty years in an effort to clarify our understanding of the elementary school child's notion of time. Much of this research has sought to trace developmental stages in understanding of various aspects of the time concept, such as seriation, chronological order, time words, telling time from the clock, time memory and the ability to detect absurdities involving time.

It is the purpose of this study to investigate the child's understanding of time duration, an aspect of the time concept generally neglected in previous research, in an attempt to determine the factors which influence its development and the stages in the child's growth at which such understanding is acquired.

II. THE PROBLEM

As defined above, duration involves the understanding of periods

of time which separate two or more events. According to Piaget (1955), the child first masters the concepts of seriation (or ordering of events) and duration during the preoperative stage of his development. It is not until the stage of concrete operations however, beyond age seven or eight, that the child is able to combine these two concepts to produce more mature concepts such as those involved in the measuring of time intervals.

If Piaget's findings are accepted, it should follow that children are first able to understand questions involving comparisons of time duration and such understanding should be evident at about age six or seven. Piaget has concluded also that children are not able to use measures of duration accurately until at least age seven or eight. It should follow that from this age onwards there is a progressive improvement in the child's ability to use such measures.

In this study it has been decided to test separately the child's understanding of comparisons of duration and his ability to use measures of duration. Understanding of comparisons will be tested in two ways. First, the child will be asked questions of a purely verbal nature requiring an indication of whether one event happened a longer or shorter time ago than another. The second approach to understanding of comparisons of the duration of time will involve situations in which the child is presented with three simple column graphs of different heights. He will then be told that the middle graph represents a certain time and will be asked to say which of the other two graphs represents another time - the "longer" graph or the "shorter" graph.

Ability to use measures of duration will be tested simply by asking the child to give the actual time involved between two events.

A factor which must be considered when attempting to assess the child's understanding of time relationships is his background of knowledge, instruction and experience. For instance, to ask a child, who lived the longest time ago, Napoleon or William the Conqueror, or how long it is since Napoleon was defeated at Waterloo, presupposes knowledge of who these figures were and the times in which they lived. Without such knowledge, testing of the child's understanding of the times involved is meaningless. He could well have a finely developed sense of time and yet be unable to demonstrate it in the context of these questions. It is likely that questions of this type have contributed to many of the confused findings of past researchers.

In an attempt to overcome this factor of general knowledge and past instruction, the questions used in this study will be based on events and experiences which are common to all children and which all children have experienced. This means that the child will not be called upon to see the time relationship of any event which occurred outside his own lifetime.

It is a basic assumption of this study that if the child shows understanding of the time intervals involved between events <u>within</u> his own experience, then instruction involving intervals of the past, <u>beyond</u> his experience, can be meaningful to him. If, as a result of this study, any recommendations for the planning and teaching of social studies courses in the elementary school can be made, they will have significance only in terms of this assumption.

Questions Which the Study Seeks to Answer

The understanding of comparisons and measures of duration will be studied in relation to the factors of sex, socio-economic status, intelligence, chronological age and grade placement. The following questions will be posed:

1. Is there any significant relationship between sex and the ability to understand comparisons and measures of duration?

2. Is there any significant relationship between socio-economic status and the ability to understand comparisons and measures of duration?

3. Is there any significant relationship between intelligence and the ability to understand comparisons and measures of duration?

4. Is there any significant relationship between chronological age and the ability to understand comparisons and measures of duration?

5. Is there any significant relationship between grade placement and the ability to understand comparisons and measures of duration?

In addition, the data will be analysed to determine the stages by which understanding of comparisons and measures of duration is reached. In this context, the following questions will be asked:

6. Is there any significant relationship between ability to understand comparisons of duration and ability to use measures of duration?

7. Are measures of duration more difficult for children to understand and use than comparisons of duration?

8. Does the ability to understand comparisons of duration precede the ability to use measures of duration?

9. Is there a progressive development with age and grade in the ability to understand comparisons of duration and the ability to use measures of duration?

10. At what stages of the child's development can it be said that he can understand comparisons of duration and can use measures of duration?

III. LIMITATIONS

Any interpretation of the findings of this study should be made only after consideration of the following limitations. An assumption fundamental to the study is that the tests used are valid measures of the ability of children to understand comparisons of duration and use measures of duration. Empirical evidence of validity cannot be provided but the test items would appear to have satisfactory face validity. Some are based on questions which were given limited use in previous studies by Oakden and Sturt (1922), Ames (1946), Bradley (1947) and McAulay (1961), but most were devised expressly for this study. It is further assumed, chiefly on the basis of Piaget's work, that the concept of duration can be isolated from other aspects of time sense and can be studied separately. It should be remembered as well that the study is based on a limited sample of urban school children and that no attempt will be made to account for the effects of past instruction in the measurement of time and practice in solving problems associated with time.

IV. THE SIGNIFICANCE OF THE STUDY

Much of the course work included in social studies programs in the elementary school is justified on the basis of its contribution to an

understanding of the way in which those who lived in earlier times have influenced our contemporary way of life. Implicit in such an understanding is an awareness of the significance of historical events and such an awareness is impossible without an understanding of time. As Flickenger and Rehage (1949) have said:

> Understanding the significance of historical events depends in a large measure upon the ability to place them accurately in time and to associate them with a given locality. (p.108)

Every teacher of social studies at the elementary level has been faced at some time with the problem of knowing to what extent her pupils understand the intervals of time involved in the past events which she describes to them. What does it mean to a child to say that a period of twenty years separated the two World Wars or that the confederation of Canada took place one hundred years ago? Unless the child has some concept of the time involved in these periods, the whole point of the instruction is missed. The basic problem facing the teacher is that she can never be certain that the child has an accurate understanding of the intervals of time involved. If, for instance, she asks how long it is since Confederation and the child answers, "one hundred years", she must accept the answer because it is the correct one. But does the child have any idea of how long a one hundred year period is? Is he simply reciting a learned response?

This study is undertaken in the hope that it will provide planners of social studies curricula and teachers of social studies with an indication of the developmental stages by which, and at which, the child is able to understand the periods of time involved between past events.

Such an indication would facilitate selection of the most appropriate levels of the elementary school for instruction in those aspects of the social studies which depend heavily on the concept of duration of time.

V. DEFINITION OF TERMS

Duration - The period of time which separates two or more events.

Comparisons of Duration - Verbal expressions of the time separating two events as being "longer than", "shorter than" or "the same as" the time separating two other events.

Graphic Comparisons of Duration - Expressions of the time separating two events as being "longer than", "shorter than" or "the same as" the time separating two other events, by reference to graphic representations of the durations involved.

Measures of Duration - Expressions of the amount of time separating two events.

General Measures of Duration - Expressions of the time separating two events in general terms such as "a long time ago" and "not very long".

Specific Measures of Duration - Expressions of the time separating two events in terms of specific and conventional measuring units such as "three hours", "six months" and "two years".

Socio-economic Status - This term refers to a numerical rating given to the subject in terms of his father's occupation, (or his mother's occupation if the mother supports the family). The ratings used are those of the Blishen Occupational Class Scale (1961).

Grade level - This term refers to the elementary school grade

in which the subject was enrolled at the time of testing. Children who were repeating a grade, or who had previously repeated a grade, were excluded from the sample so the term "grade level" may be considered synonymous with "years of schooling".

VI. THE EXPERIMENTAL SETTING

In order to conduct this investigation, a sample of two hundred and twenty-eight children was selected at random from three elementary schools within the Edmonton Public School System. Thirty-six of these children, three boys and three girls from each grade in one of the schools, were used in a pilot study. For the study proper, the remaining one hundred and ninety-two subjects, from the other two schools, were used. A test, composed of three subtests, each consisting of ten simply worded items, was designed by the writer and administered to each subject. Some of the items were based on those used by previous investigators but most were devised expressly for this study.

Subtests 1 and 3 (comparisons of duration and measures of duration) required only simple verbal responses. In Subtest 2, (graphic comparisons of duration), the subject was asked to indicate his answer by pointing to the most appropriate of a series of graphic representations of information. The individual testing situation, the simply worded oral questions and the simple methods of response were chosen because of the wide age and maturity range of the sample. The responses of the subjects were recorded, for later analysis, on a specially prepared data collection sheet. (See Appendix B).

Testing for the pilot study was conducted in mid March, 1967 and the investigation proper was carried out during the last two weeks of April, 1967.

VII. OUTLINE OF THE REPORT

The present chapter states the problem and provides the reader with a general overview of the study. In Chapter II, research related to the problem and to the study will be reviewed. Chapter III will describe in detail, the experimental design of the study and the statistical procedures used to analyse the data. Chapter IV will be devoted to reporting the results of the analysis of the data and will include a brief description of observations made during the testing program. Chapter V will summarise the study and list conclusions, implications, and suggestions for further research.

CHAPTER II

A REVIEW OF THE RELATED RESEARCH

From the research material available on the development of the child's concepts of time and chronology, it is possible to distinguish three broad areas of concentration. The first of these has been concerned chiefly with the stages at which children develop various concepts of time and includes research into the understanding of time terms, chronological order and duration. The second has included more specific aspects of time sense such as understanding of indefinite time expressions, clock time and time lines. The third and most recent area of concentration has dealt with the possibility of accelerating the development of time concepts in children through specific training. As is to be expected, research in any one of these three areas sometimes overlaps into the others, but this classification provides a working basis for a review of the research done in the field.

The studies included in this review have been selected from each of these three broad areas of concentration and are those which are considered to be of good design and which have made significant contributions to the field of study.

I. STUDIES RELATED TO THE STAGES OF GENERAL TIME CONCEPT DEVELOPMENT

One of the earliest studies of the development of the knowledge of time in children was conducted by Oakden and Sturt (1922). In this study,

eight separate time concept tests were given to samples of English children ranging in age from four to fourteen. The size of the sample was different for each test, varying from ninety-eight to three hundred and seven subjects. From this study it was concluded that the acquisition of time concepts is a slow process beginning as early as age four and reaching an adult level of maturity at age thirteen or fourteen. A very significant period of development was observed around age eleven when children showed a rapid improvement in all aspects of time knowledge.

Oakden and Sturt were able to distinguish two separate stages in the development of time sense. At first, the child develops a knowledge of time words in ordinary use. In this stage, much use is made of concrete experience. Seasonal changes, for instance, are seen in terms of natural phenomena rather than as set phases of time. The order in which these time words are acquired depends on the frequency with which they are encountered and their personal significance to the child. Parts of the day, for example, are mastered before days of the week and birthdays and holidays are among the first to be learned.

The transition from knowledge of time terms to the second stage of development, the understanding of chronology, sequence of events and duration, was found to be a difficult one. Children distinguish first between past and present, usually at about age eight, but for some time the past is viewed only as a vague "entity". It is not until age eleven that the child is able to recognise subdivisions of the past and even when he can do this, great difficulty is experienced in ordering dates correctly and in assigning dates to people and events. It was further found that

questions involving duration are "clearly the hardest" and that only 30% of nine and ten-year-olds can answer them correctly. From a survey of the various test results, the final conclusion was drawn that time plays a less important role than space in the child's thought processes.

Bradley (1947), using samples of from fifty-seven to one hundred and seventy-seven subjects in a replication of the Oakden and Sturt study, concluded that by age five the child's understanding of time words is very meagre but that a rapid improvement takes place during the next two years and by age seven, the child has a relatively sound knowledge of time terms. Bradley found also that time knowledge involving the element of duration is the last to develop and the most difficult for the child to understand. He discovered that although nine-year-olds "can comprehend a long period of years", understanding of measures of duration does not reach satisfactory proportions until about age twelve. Other findings of the Bradley study support those of Oakden and Sturt except that the sudden improvement in time knowledge at about age eleven, reported by the latter, was not observed. The process of acquiring time knowledge was seen by Bradley as being essentially gradual, even and continuous. As the results and scoring methods used in both studies were essentially the same, there appears to be no satisfactory explanation for these conflicting findings. It is possible that sample differences could in part account for the conflict but this cannot be definitely assumed because in neither study is the sample adequately described.

It should be noted however, that Uka (1956), also found a speeding up in the growth of time concepts, as measured by understanding of time

terms, between the ages of ten and eleven, thus supporting the Oakden and Sturt view. In addition, Uka found that there were "consistent and positive" differences between the sexes within the various age groups.

A further study concentrating on children's understanding of commonly used time terms was conducted by Harrison (1934). The subjects for this study were one hundred and sixty children from kindergarten through third grade. Harrison used as her scoring device, a seven point scale of the degree of comprehension of the chosen time words. This study indicated a steady, continuous growth in complete comprehension of time terms from grade to grade and a steady decrease in the number of responses which indicated partial or confused comprehension or lack of comprehension. Harrison found in fact, a correlation of .66 between the understanding of time terms and grade placement. Further analysis of the results yielded correlations of .70 for mental age and .58 for chronological age. On the basis of these figures, Harrison was prepared to postulate, perhaps unjustifiably:

> Concepts of time develop in closer agreement with inner maturation, as indicated by mental maturity, than with training and experience, as indicated by chronological age and grade placement. (p.513)

A similar study was conducted by Friedman (1944). His approach was to construct two separate tests, the first of which, administered to children in kindergarten and grades one to three, he called the "primary test". Its function, as with the previously discussed study, was to sample the child's understanding of conventional time terms. The second test, referred to as the "intermediate test", was administered to children in grades four, five and six and was designed to follow-up the concepts

sampled in the "primary test" and to look at a wider variety of time concepts, such as those involved in the use of indefinite time expressions, time lines and chronological sequence.

Friedman concluded that by the time children reach grade six, they have a satisfactory understanding of conventional time terms but an unsatisfactory understanding of chronological order and specific time words and dates. He warned that concepts of duration are very difficult for the child to understand and should be used "with appreciation of the fact that to children their meanings are greatly varied and often inaccurate and vague". It was found that time lines were understood by only a very few pupils; in fact, by only 27% of pupils at the grade six level. Factors of sex, I.Q. and socio-economic status were not found to contribute significantly to the findings of the study.

The studies so far described have concentrated on the development of time concepts of children of elementary school age. In a different type of study, conducted by Ames (1946), emphasis was placed on children aged from eighteen months to eight years. This study was based on a sample of ninety-five subjects. Children of high or superior intelligence, ranging in age from eighteen to forty-eight months, were observed through a one-way-vision screen as they indulged in free or directed play and their verbalisations were recorded and analysed over a period of two years. In addition, the children were asked a series of questions designed to test time concepts. Children in the age group from five to eight years were asked the questions only and were not observed in the same way as the younger children.

Ames concluded that within any one level of age and intelligence,

there are marked individual differences in children's concepts of time. Despite these differences, understanding of time concepts seems to develop in a relatively set pattern and at approximately the same time for all children. This finding led Ames to hypothesize that maturation is a vital factor in the development of time concepts.

Ames further found that the concept of "present" is the first to appear in the young child. By the age of twenty-four months he can use the term "today" correctly. This is followed at thirty months by the concept of "tomorrow" and at thirty-six months by "yesterday". In the mastery of any of these concepts there is a set pattern. At first the child understands what the word means without being able to use it. He then uses the word spontaneously and finally, can answer questions which deal with the concept. Similarly, time words are used in specific contexts before they are generalised. The child has a rather sound concept of "order" by about the age of thirty months but the concept of duration does not appear before at least the age of thirty-six months. This study however, provides one of the few clues that the ability to use measures of duration might develop earlier in the child than is generally thought to be the case. In response to the question, "how long do you stay in school?", Ames was able to elicit from seven-year-olds, the response, "four-and-a-half hours".

Ames sets down various age levels at which children master some of the common concepts of time. By age four, the child knows whether it is morning or afternoon and can tell what day it is by age five. Knowledge of months and seasons does not appear until age seven and the ability to tell

the days of the month and the year is not acquired until age eight. Most children know their age by the time they are three; their birthday by the time they are four and when they are five, they can tell how old they will be next birthday.

A most comprehensive report on the stages of development of time sense in young children has been made by Piaget (1955). Most of his work was concerned with the stage of child development which he calls the "preoperative" stage, from age two to age seven or eight, but he mentions briefly as well, development in the "sensori-motor" stage, from birth to age two, and the period of "concrete operations", from age eight to age eleven or twelve.

In the sensori-motor stage, Piaget sees the first signs of awareness of "before" and "after" relationships developing somewhere between the ages of four months and eight months. Before this, the child has no sense of time order or sequence and perhaps only the vaguest sense of time duration. By the time the child is twelve months old he has shown the first signs of being able to recall a past event. By the age of eighteen months, he can retain memories of events for longer periods of time and from the age of eighteen months to two years, can recall progressively more distant events to memory. Flavell (1965) admits that evidence of such development in this early stage is very difficult to find and that Piaget, in an attempt to reach some rudimentary understanding of the infant's concepts of time, is willing to risk "a fair amount of ambiguity and shaky conjecture".

Piaget's treatment of the preoperative stage is more specific. Through a series of experiments, he sets out to show that the concept of

time contains the two separate abilities of ordering events in sequence and seeing duration of intervals between events, and that both of these abilities are closely linked to the child's concepts of speed and distance. The experiments, performed individually for each child, were based in the main on situations involving the moving of toy cars and dolls at different or identical speeds across a table. The child was asked such questions as "which car arrived first?", "which car travelled the fastest?" and "which car travelled for the longest time?".

From these experiments, and other similar ones involving differential rates of water flow, Piaget was able to see that the development of the concept of time implies the progressive structuring of perceptual data by a sequence of logical operations. The first of these operations is that of seriation. The child realises that event A happens before event B, then comes event C and so on. At the same time, the child realises that events can happen simultaneously. Next comes the concept of duration when the child realises that the time taken for an object to move from point A to point B is less that the time taken from point B to point C. Interestingly, some children grasp seriation before duration and others understand duration before seriation. It is an important point in Piaget's theory however, that the child cannot begin to develop complete concepts of time until he has grasped both, and this does not occur until he has reached the stage of concrete operations, beyond age seven or eight. When this stage is reached, the child is able to progress to an understanding of co-ordination of durations, that is, the time taken from A to B, together with the time taken from B to C, must equal the total time A to C. From

this develops the notion of a system of measuring time. If AB and AC are the same, then the child can see each as occupying a "unit of time" and AC would then be seen as taking up two such units. In these later developments, Piaget sees corresponding parallels in concepts of speed.

The only significant attempt to follow-up the work of Piaget appears to have been a study conducted by Lovell and Slater (1960). This study made use of experiments similar to those used by Piaget and concentrated on the aspects of simultaneity, equality of synchronous intervals and order of events. From schools in England, fifty children, considered to be of average or above average attainment, were placed in age groups from five to nine years. Another group of fifty children was chosen from schools for the subnormal. After individually administered tests, Lovell and Slater found that overall, children of this age group had a good notion of order of events and that under certain circumstances, their ability to co-ordinate instants and intervals to provide a concept of time could be improved. It was found however, that the child's sense of time is not developed to the same extent and degree in all time sense situations. Subnormal children of age seventeen or eighteen were found to have a time sense equivalent to that of a normal nine-year-old.

Research in recent years has tended to swing away from the Ames, Piaget and Lovell and Slater approach, back to the earlier approaches which emphasised oral and written tests. One such study was conducted by Chase (1961). This study concentrated on the differential rates of development brought to light by Lovell and Slater. The test used was based on one used earlier by Callahan (Chase, 1961). It required the subjects,

one hundred and ninety-two fifth grade and two hundred sixth grade children, to place correctly in chronological order, five items in each of twenty-four questions. From the results Chase was able to see, not only the expected higher understanding of the sixth grade pupils but also, an indication of very significant differences between individuals within the grades. Interestingly, Chase found that boys seemed more capable of arranging events in chronological order than girls, in both grades. As well, he discovered that children in both grades were better able to put events in order when these events were related to the present rather than to some past event.

Oral questions, concerned primarily with comparisons of duration, were used in a study of children's time concepts by McAulay (1961). He found that second grade children tend to have a better understanding of the remote past than the immediate past and that their understanding of the removed environment is better than their understanding of the immediate personal environment. The child is able, for instance, to understand time relationships between Indians and white pioneers better than the time relationships between mother and child. The child also appears to have some understanding of periods of past time, especially if these periods are centered around events rather than people or places. This finding is most significant in view of Sturt's earlier conclusion that the ability to see and understand the past does not develop until the child is about eight years of age and the ability to distinguish different areas of the past until age eleven. It is significant also in that it contradicts a study done by Farrell (1953). In this study, carried out on five, six

and seven-year-old children of high I.Q., it was found that concepts of the "present" and the "immediate past" were more easily understood by children of lower I.Q. than concepts of the "future" and "distant past". This implies of course, that the immediate past is understood before the "remote past".

The reason for the conflicting findings of McAulay and Farrell is not apparent. It is possible that the types of questions asked of the children could account in part for the conflict but this must only be conjecture as Farrell does not give adequate details of the questions she used. The conflict suggests that in either or both of the studies, the child's notion of the past was confused by his general knowledge and his past experience.

II. STUDIES RELATED TO THE DEVELOPMENT OF SPECIFIC ASPECTS OF TIME SENSE

Because of the complicated nature of time sense, it is not surprising that at various stages, investigators have attempted to isolate and trace the development of specific aspects of it.

One of the most significant of these aspects has been the child's understanding of indefinite expressions of time, such as "recently" and "in the Middle Ages". Kelty (1925) was among the first to attempt a study of such understandings and her work showed that there is a steady increase in the number of pupils from grades four to six who find it easier to understand definite rather than indefinite expressions of time. Kelty's work was followed in 1936 by Wesley (1942), who tested the understanding of

indefinite expressions of time of high school students, college seniors and graduate students. It was found that the college seniors and graduate students exhibited a far superior understanding to that of the high school students. Even so, there were some unusual responses from some of the college group. "The beginning of modern times", for instance, was listed by one college student as 1925.

A more recent and more thorough study in this area was conducted by Gill (1962). In this study, which used the same type of test that Wesley had used, the terms tested were taken from commonly used text books and from classroom discussions. The subjects, ranging from grade five through to college seniors and prospective teachers of social studies, were asked to give definite dates for eighteen common terms. Gill found that indefinite expressions of time were loosely interpreted at all grade levels. Students in the higher grades, especially the college students, showed a better grasp of the concepts but there were many items which showed no clear development from grade five through grade twelve. Of the terms tested, it was found that "century" and "decade" were poorly understood and that notions of "ancient times", "middle ages" and "modern times" had little meaning for many of the subjects, particularly those in the lower grades.

Another specific area of time sense was investigated by Springer (1952). Her study dealt with the ability of four, five and six-year-olds to understand and use conventional clock time. Springer found that ability to perform tasks with a clock face increases consistently with age and follows a set pattern of development. The child is first able to give times of various activities in his daily routine, in descriptive terms.

He then gives an unreasonable time for the events. This is followed by a reasonable but incorrect time and finally, by the correct time. In the next stage of development, the child can tell the time from a clock face using first hours, then half hours and quarter hours. Finally he is able to set a clock face in the same order and can explain why a clock has two hands and the functions these hands serve.

A study by Mascho (1961) found that a large percentage of kindergarten and first grade children can tell the time by the hour. In addition, he concluded that the children in his sample were more familiar with time and money ideas than with other concepts of measurement.

One of the most interesting of the specific areas of time sense, from the teacher's point of view, is the child's understanding of time lines. Strangely enough, the only study of such understanding in elementary school children has been that of Friedman (1944) which has previously been discussed. In a more recent study, Davis (1966) made use of eighty-one students in grades eleven and twelve, to test the usefulness of time lines in learning chronological relationships in text materials. From his study, it was found that time lines are most useful to students of relatively high I.Q. and that such lines, whether correct or incorrect, seem to help brighter children to learn chronological relationships presented in a printed verbal passage. These findings have implications at the elementary level, according to Davis, who sums up his study with the very significant statement that educational level and intelligence should be considered in the use of time lines and that their continued indiscriminate use does not seem to be warranted.

III. STUDIES RELATED TO THE ACCELERATED DEVELOPMENT OF TIME CONCEPTS

It is perhaps natural that many investigators from time to time have wondered whether or not time concept development can be accelerated by specific training. The first to consider such a possibility appears to have been Pistor (1940), who set up an experiment to see if history instruction assists the development of time concepts. Two groups were used in this study, each made up of three hundred and twenty grade six pupils ranging in mental age from 10.0 to 12.11. The first group contained children who had worked through separate courses in history and geography. The children in the second group had done only geography courses with history used incidentally, usually to explain some geographical point.

The children in both groups were given an initial battery of time tests, constructed by Pistor (1939), at the beginning of grade six, to see whether or not the method of previous instruction in grades four and five had influenced the development of their time concepts. Pistor found that the scores of both groups were almost identical. Both groups were again given the same battery of tests at the end of grade six, after the "history" group had been taught for a year with methods emphasizing chronology and the "geography" group with only incidental mention of chronology. It was found that the mean scores of both groups at the end of grade six were almost identical. Pistor concluded that maturation, rather than training, is the dominating factor in time concept development.

Pistor's findings were not seriously questioned until Arnsdorf (1961) conducted a similar experiment with five hundred and sixty-three

sixth grade children. The subjects were divided into two groups. Each group was taught the same social studies unit from the same text book for a period of seven weeks, the only difference being that one of the groups was given specific instruction in time terms which appeared in the unit. At the conclusion of the seven week period, both groups were given an original battery of six separate tests to measure understanding of time concepts. The results of the study showed that, as gauged by the battery of tests, children in the experimental group had a significantly greater understanding of time concepts than those in the control group.

Arnsdorf's work has been followed in recent years by a number of studies, all of which point to the fact that training can assist the development of time concepts. Davis (1963), discovered that at the end of a three week period, the time concepts of fourth, fifth and sixth grade children who had been given specific instruction in geographical time zones, were significantly more advanced than those of children who had not received such instruction. In the same year, Dobbs (1963) attempted to identify concepts, skills and generalizations which are important in the development of time sense and chronology, by surveying texts in science, arithmetic and social studies. Systematic instruction of these terms in a sixth grade experimental-control group situation was found to be beneficial. It was found also that boys in the experimental group had a better understanding of time intervals than girls but that the girls' understanding of time words was more developed than that of the boys. Stephens (1964) set up two groups, each containing eighty kindergarten children. One group was given specific instruction in time terms while

the other received only incidental mention of such terms. After a six week period, it was found that training led to specific gains. In addition, children of high I.Q. in the experimental group were found to learn more about time concepts than those of lower I.Q. A recent study by Becker and Gontner (1966) found that instruction in common time words assisted the development of time concepts of children in a grade one sample. Younger children in the experimental group were found to benefit more from this instruction than the older children.

IV. THE RELATIONSHIP OF PREVIOUS RESEARCH TO THE PRESENT STUDY

From the studies surveyed, it may be concluded that concepts of time develop in the child as a result of many factors, beginning at least as early as age four and reaching an adult level of maturity sometime during the early years of secondary school during the stage of development which Piaget has termed the stage of formal operations.

Some studies indicate that sex differences are significant in the development of time concepts but the evidence is far from conclusive. Little is known of the effect of socio-economic status or home background on such development. Intelligence however, has been noted in a number of studies to be a significant contributor as brighter children tend to master the concepts more quickly than others.

It is extremely difficult to fix age levels at which children master various aspects of time sense but a general pattern of development may be seen. The child first masters the use of conventional time terms

in his vocabulary, beginning with those terms associated most closely with his everyday life and progressing by about age seven or eight to the more general terms involved in our system of time measurement, including clock time.

Ability to understand duration of time and order of events appears to be established at about the same age but is extremely difficult to test because of the influence of the child's general knowledge and experience. The use and understanding of dates and the ability to give specific measures of duration involving intervals of time in the distant past both depend heavily on such general knowledge and experience but are assumed to be satisfactorily developed by the end of the elementary school years. The more specific aspects of time sense involved in the understanding of indefinite expressions of time and time lines appear to be even later in developing.

Considerable evidence exists for assuming that the development of time concepts can be accelerated by specific instruction in subjects and ideas involving time, not only at the upper elementary levels, as was previously thought to be the case, but as early as grade one.

In general, studies in the area of time concept development have attempted to cover too wide a scope with the result that the conclusions drawn about specific aspects of time sense are often too general to be of value. There is a need for a closer and more detailed look at these specific aspects of the child's knowledge and understanding of time.

Despite the research information available about children's time concepts, some questions remain unanswered. Little is known, for instance,

of the connection between the child's general language development and the development of his time concepts. Of particular interest to teachers is that almost no research has been done on the value of time lines to the child and yet such lines have long been considered a vital part of social studies instruction. Nothing is known of the connection between mathematical ability and the ability to arrange events in chronological order. Very little is known about how the child views the future and whether he has more difficulty in conceptualising future time than past and immediate past time.

But foremost among the unanswered questions are those concerned with duration. Little, if anything, is known of the stages through which children must pass in their understanding of duration of time intervals. Piaget tells us that by age eight, the child understands the concept of duration but this does not answer all of our questions. Does the child understand only that one period of time is longer than another or is he able to "visualise" actual periods of time? When the grade four teacher speaks of an event which happened twenty years ago, does the child have any idea of the time involved or is it just "a long time ago"?

The pattern of development of understanding of other aspects of time sense, such as knowledge of time words and ability to use clock time, suggests that a pattern of developmental stages might also exist with regard to the mastery of duration. No attempt has been made to isolate these stages or to establish such a pattern.

At what levels do children understand comparisons of duration? When do they begin to use and understand general and specific measures

of duration? In effect, when are they able to comprehend the time intervals which we use so frequently in elementary school social studies lessons?

These questions, vital to meaningful social studies instruction, deserve investigation.

In this study, an attempt will be made to determine the factors which influence the child's understanding of comparisons and measures of duration and the stages by which such understanding is acquired.

CHAPTER III

THE EXPERIMENTAL DESIGN AND STATISTICAL PROCEDURES

This chapter contains an explanation of the selection of the sample, a description of the test battery, including details of its construction, refinement and administration, an explanation of the intelligence ratings assigned to the subjects and a discussion of the statistical procedures used to analyse the results of the study.

I. THE SAMPLE

The sample for the study was selected from three elementary schools within the Edmonton Public School System. One of the schools was used solely for the purposes of a pilot study in which the adequacy of the testing instrument was assessed. The sample for the investigation proper was drawn from the other two schools.

For the pilot study, a school was chosen from what was considered, by personnel of the Edmonton Public School Board, to be a middle socio-economic class area. Three boys and three girls were selected at random from each grade, one to six, making a total of thirty-six subjects.

For the main investigation, two schools were used for the following reasons. First, as the effects of socio-economic status were to be studied, it was considered advantageous to draw half of the sample from a school judged to be in a relatively low socio-economic area and the other half from a school judged to be in a relatively high socio-economic area. Once again, the schools were selected on the advice of personnel attached

to the Edmonton Public School Board. Second, it was considered more practical to use two schools in the investigation, simply to obtain as large a sample as possible without unnecessarily interrupting school schedules and routines.

In the two schools used for the main study, the procedure for selecting the sample was as follows. In each school, alphabetical class lists were obtained for all pupils in the school. Teachers were then asked to delete the names of any pupils who were repeating a grade or who had previously repeated a grade, any pupils, such as recent immigrants, who had English language difficulties, and any pupils who were placed in accelerated programs. From these amended class lists, final lists were prepared for each grade. Next, for each sex, the subjects were assigned a number. A table of random numbers was then consulted and eight numbers were chosen representing eight subjects. This procedure was repeated for each sex in each grade resulting in a final sample of eight boys and eight girls from each grade, one to six inclusive, in two schools - a total sample of one hundred and ninety-two.

II. THE INSTRUMENT

Each subject was involved in one individual testing situation in which a test, consisting of a battery of three subtests, was administered. The battery was designed expressly for the study and, apart from its use in the pilot study, had never been previously administered. It should be remembered however, that some of the items were based on others used by previous investigators. A copy of the final form of the test, incorporating

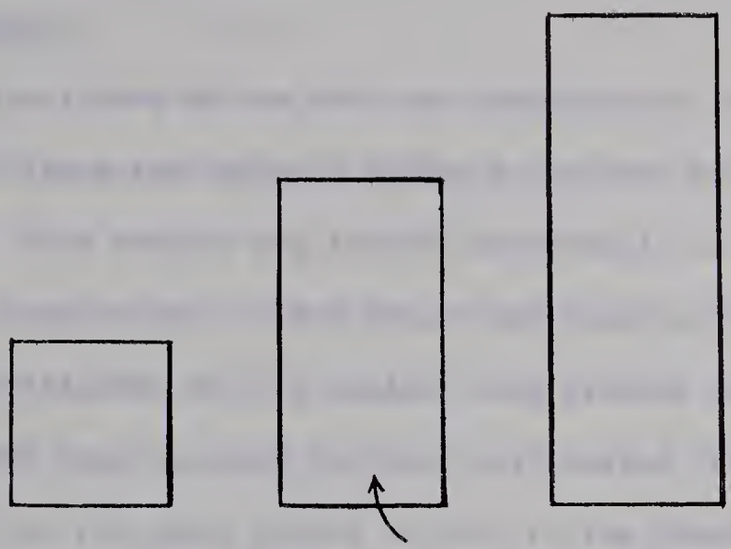
changes made as a result of the pilot investigation, is included in Appendix A. The battery was designed to test the child's understanding of three separate aspects of the concept of time duration. A description of each of the subtests of the battery follows.

Subtest 1 - Comparisons of Duration

This subtest was designed to measure the child's understanding of simple verbal comparisons of duration. Each of the ten items in the subtest required a response which would indicate whether or not the child understood that one period of time was longer or shorter than another. For example, the child was asked, "Which is longer, recess or lunch time?". To answer the question, he was required simply to state which one he considered to be the longer period of time.

Subtest 2 - Graphic Comparisons of Duration

This subtest was designed to measure the ability of children to distinguish different durations of time when the choice of responses was presented in graphic form. The information presented in the ten items of this subtest was the same as that presented in the items of subtest 1, the only difference being that the graphic presentations provided the child with the opportunity to reason with concrete material rather than with abstract verbal material. This subtest was included in an attempt to determine whether or not any differences exist between the child's ability to handle verbal comparisons of duration and his ability to handle concrete representations of these comparisons. As an example of the type of item contained in this subtest, the child was presented with this diagram.



The examiner would then point to the centre column and say, "If this one shows you how long lunch time is, which one would show you how long recess is?". To answer the question, the child was required to point to either the left-hand column or the right-hand column.

Subtest 3 - Measures of Duration

This subtest was designed to measure the child's ability to use specific and general measures of duration. It differed from the other subtests in that the responses required were not of the "either-or" type. A definite measure of some sort was necessary for each item. For instance, the child was asked, "How long do you have out of school at lunch time?". To answer the question, a specific response such as "two hours", or a more general response such as "not very long", was required. The subtest was composed of ten such items.

III. THE TESTING PROGRAM AND METHOD OF SCORING

I. The Program

The final form of the test was administered to a sample of one hundred and ninety-two subjects during a two week period at the end of April 1967. Each subject was tested individually in a separate room provided by each school. Every effort was made to avoid interruptions and only the investigator and one subject were present during any test. It was found that the time required for each test varied from five to six minutes for children in the upper grades to nine to ten minutes for children in the lower grades. As each subject entered the testing room, the investigator explained the nature of the test, administered a trial question which introduced the types of items in each subtest, and generally, tried to put the child at ease.

The questions were presented in such a way that the child was not aware that he was doing three separate tests. Item 1 of Subtest 1 was followed by item 1 of Subtest 2, then item 1 of Subtest 3. Then came item 2 of each subtest and so on. This pattern of questioning was considered desirable because of the similarity of the items across the three subtests.

II. The Scoring

For purposes of scoring the subtests, a special data collection sheet was prepared. (See Appendix B). The subject's responses were recorded as they were given and were later scored. The methods used to score the subject's performance on each of the subtests were as follows.

Subtest 1 - Comparisons of Duration

The subject's response was scored as either correct or incorrect. If the correct response was given, the subject received a score of 1. If the incorrect response was given, he received a zero score. If either of the responses, "I don't know", or "They are both the same" was given, this was considered as evidence that the child could not distinguish between the two durations presented and accordingly, a zero score was given. Under this system of scoring, the maximum possible score for Subtest 1 was 10.

Subtest 2 - Graphic Comparisons of Duration.

If the correct column was chosen, a score of 1 was given. If the incorrect column was chosen, a zero score was given. As in Subtest 1, a response of "I don't know" was given a zero score on the assumption that the child was unable to distinguish the different durations involved. If the child selected the centre column, the question was rephrased to ensure that it had not been misunderstood. If he persisted in his choice of the centre column, a zero score was given on the assumption that he considered the two intervals to be the same length. The content of the test items in Subtest 1 and Subtest 2 was identical, the only difference being in the manner of presentation. The system of scoring, as in Subtest 1, allowed a maximum possible score of 10.

Subtest 3 - Measures of Duration

Because of the nature of the responses required in this subtest, a different system of scoring from that used for the other two subtests was

employed. Two separate methods of scoring, described below, were used in an attempt to distinguish the levels of precision reached by the subjects in their responses.

a. Method 1 - Restricted Measures Score. A list of answers, considered to be "precise" by reasonable adult standards, was prepared by the investigator. (See Appendix B). For the question, "How much time do you have out of school at lunch time?", the required answer was "one-and-a-half hours". If the child gave this response, he was given a score of 1. Any other response was given a zero score. When scored by this method, the subtest had a maximum possible score of 10. (This system of scoring is used in the item analysis of the test and in the attempt to compare performance on the three subtests.)

b. Method II - Full Measures Score. In addition to the "precise" list above, a second list of "acceptable" answers was prepared by the investigator. These were considered to be precise enough to be acceptable under normal circumstances as "rough guides". (See Appendix B). For the question, "How much time do you have out of school at lunch time?", the acceptable responses were "one hour", "one-and-a-quarter hours" and "one-and-three-quarter hours". For a response of this type, the child was given a score of 1. If he gave a response considered in terms of the first list to be precise, he was given a score of 2. When scored in this manner, the maximum possible score for the subtest was 20. (This method of scoring is used in the correlation and linear regression analyses of the study.)

Additional Comments on the Scoring of the Subtests

Reference is made in parts of this study to the "comparisons total

score". This is simply the total of the scores of Subtests 1 and 2. It is considered legitimate to combine these two subscores because the items of both subtests cover the same material and the number of items which the child could be expected to answer correctly, purely by guessing, is the same in each.

Reference is also made in the study to the "corrected comparisons score" and the "corrected graphic comparisons score". These scores are used for purposes of comparing performance on all three subtests and are calculated by correcting the raw scores of Subtests 1 and 2 for guessing. It is assumed that these corrected scores provide an estimate of the number of items in Subtests 1 and 2 for which the child knew the answer. (Gulliksen, 1961).

IV. THE PILOT STUDY

The final testing instrument as described above, is a refined version of the initial instrument used in the pilot study. The chief changes made in the test as a result of this preliminary study were as follows.

Item Changes

Each item of the three subtests was analysed in relation to every other item to determine its internal consistency and reliability. Of the ten items in Subtest 1, it was found that items 2, 3 and 7 were not discriminating as well as the other items. In their original form, these items read:

2. Which is longer, from the start of school to lunch time or from lunch time to supper time?

3. Which is longer, the time you spend at school each day or the time you sleep at night?

7. Will you have to wait longer for next Halloween to come or for next Christmas to come?

Close examination of these items in relation to the other items of the subtest revealed that the child could be confused by their wording. The items were revised as follows, to make their meanings more explicit.

2. Which is longer, the time from when you come into school in the morning until lunch time, or from lunch time to supper time?

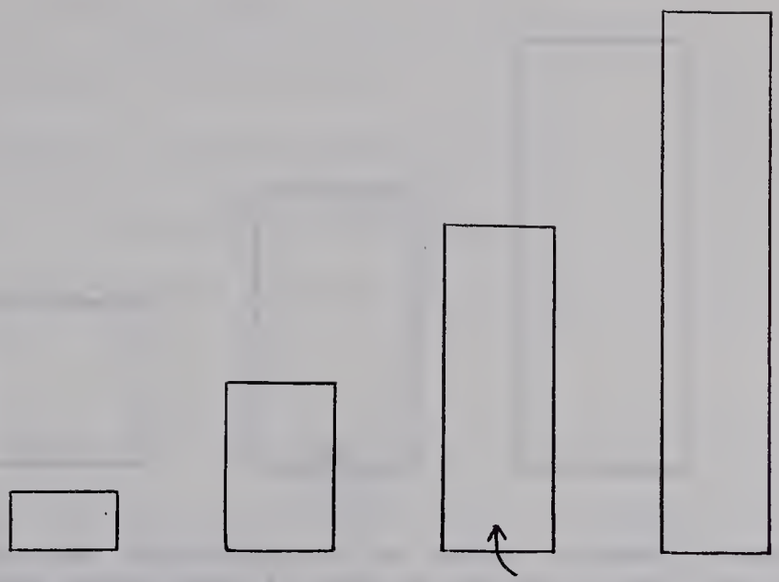
3. Which is longer, the time you spend inside the school each day or the time you sleep at night?

7. Which will come first, next Halloween or next Christmas?

All other test items were considered to be functioning satisfactorily and were therefore unchanged in the final version of the test.

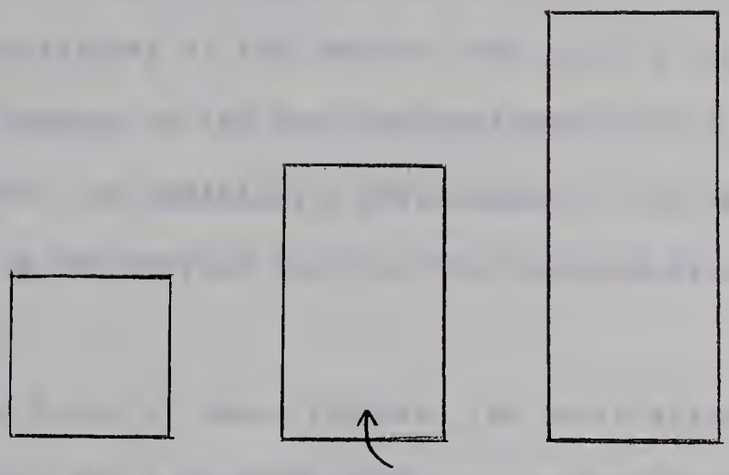
Changes in Test Format

In its original form, Subtest 2 was made up of items of a slightly different nature. The questions were the same but instead of two possible choices, there were three and the graphs were drawn in proportion to the times involved. For example, the original version of item 1 was as follows:



"If this one (pointing to the second column from the right) shows how long lunch time is, which one shows you how long recess is?"

The child was expected to select the first column on the left and for this response, would be given a score of 2. If he selected the second from the left, indicating that he knew that recess was shorter than lunch time but that he was unable to see the proportionate differences involved, he would be given a score of 1. It was found that out of a total of 360 responses to the items of Subtest 2, only 35 were of a type gaining a score of 1. It was therefore considered that the inclusion of this choice did not add significantly to the usefulness of the questions and in fact, only helped to complicate them. The items were therefore revised to remove this third choice and to remove the proportional nature of the columns. The revised item thus became:



"If this one (pointing to the centre column) shows you how long lunch time is, which one would show you how long recess is?"

As a result of this revision, exactly the same sets of columns were presented for each item. The child had to decide only which column to select, the "longer" or the "shorter" and did not have to consider proportional representations of the times involved. This revision meant also that both comparisons subtests had the same possible maximum of 10.

V. METHOD OF ASSESSING INTELLIGENCE SCORES

In this study, it was decided to use available scores of intelligence rather than to administer separate tests. This was done because of the difficulty of obtaining comparable scores on any one test over such a wide age and grade range.

The only scores available for all subjects were those of the Detroit Beginning First Grade Intelligence Test. For fifty-seven of the subjects, mostly in grades four to six, Lorge-Thorndike Intelligence Test scores were also available. A Pearson product moment correlation

coefficient was calculated for the fifty-seven pairs of Detroit and Lorge-Thorndike scores and was found to be .675.

The publishers of the Detroit test quote a correlation of .76 between performance on the test and performance on a retest after a period of four months. In addition, a correlation of .76 is reported between performance on the Detroit test and the Stanford-Binet test. (Engel and Baker, 1937).

On the basis of these figures, the correlation of .675 found between Detroit and Lorge-Thorndike scores of subjects in this sample was considered sufficient justification for use of the Detroit scores alone in this study.

VI. THE STATISTICAL PROCEDURES

As the three subtests used in the study were designed by the investigator, the relationship between them will be statistically checked. An item analysis of each of the subtests will be carried out. The internal consistency of the tests will be used as a basis for estimating their overall reliability. In addition, intercorrelations between performance on the three subtests will be found.

The relationship between the subject's scores on the subtests and the variables of sex, socio-economic status, intelligence, chronological age and grade placement will be found by examining the intercorrelations between the scores and these variables. If these correlations are found to be significant, multiple linear regression techniques will be used to assess the contribution of each of the variables towards the prediction of subtest scores, in the presence of the other variables.

CHAPTER IV

THE RESULTS OF THE INVESTIGATION

This chapter presents a summary of the test results for the sample, a brief comment on some observations which arose from the testing situation and a detailed description of the statistical analyses used to evaluate the test results in terms of the questions posed.

I. SUMMARY OF THE TEST RESULTS FOR THE SAMPLE

The Sample

The sample for the study was made up of one hundred and ninety-two elementary school children randomly selected from two schools within the public school system of Edmonton, Alberta, Canada. The sample consisted of thirty-two subjects from each of grades one to six inclusive and was made up of sixteen boys and sixteen girls from each grade. The ages of the subjects in the sample ranged from six years four months to thirteen years two months. The intelligence range, taken from available school records of Detroit Beginning First Grade scores, was from seventy-seven to one hundred and forty. For the sample, the ratings of socio-economic status, as measured by the Blishen Occupational Class Scale, ranged from 37.5 to 82.5. The distributions of socio-economic ratings for each school are shown in Figure 1 and the means of chronological age and intelligence for each grade level are shown in Table I.

The Test

A copy of the test used in this study is contained in Appendix A.

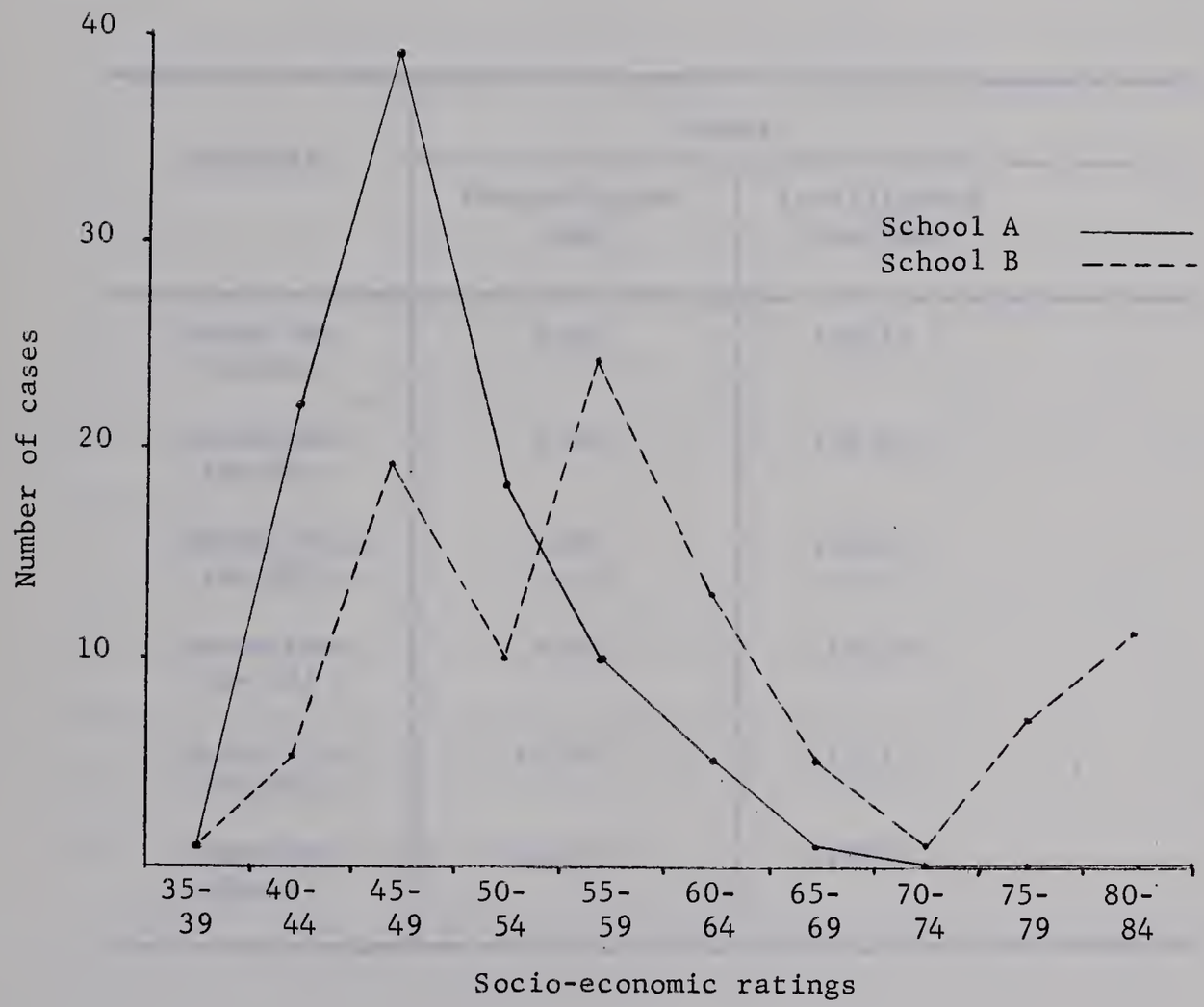


FIGURE 1

DISTRIBUTION OF SOCIO-ECONOMIC STATUS

RATINGS FOR THE TWO SCHOOLS USED

IN THE STUDY

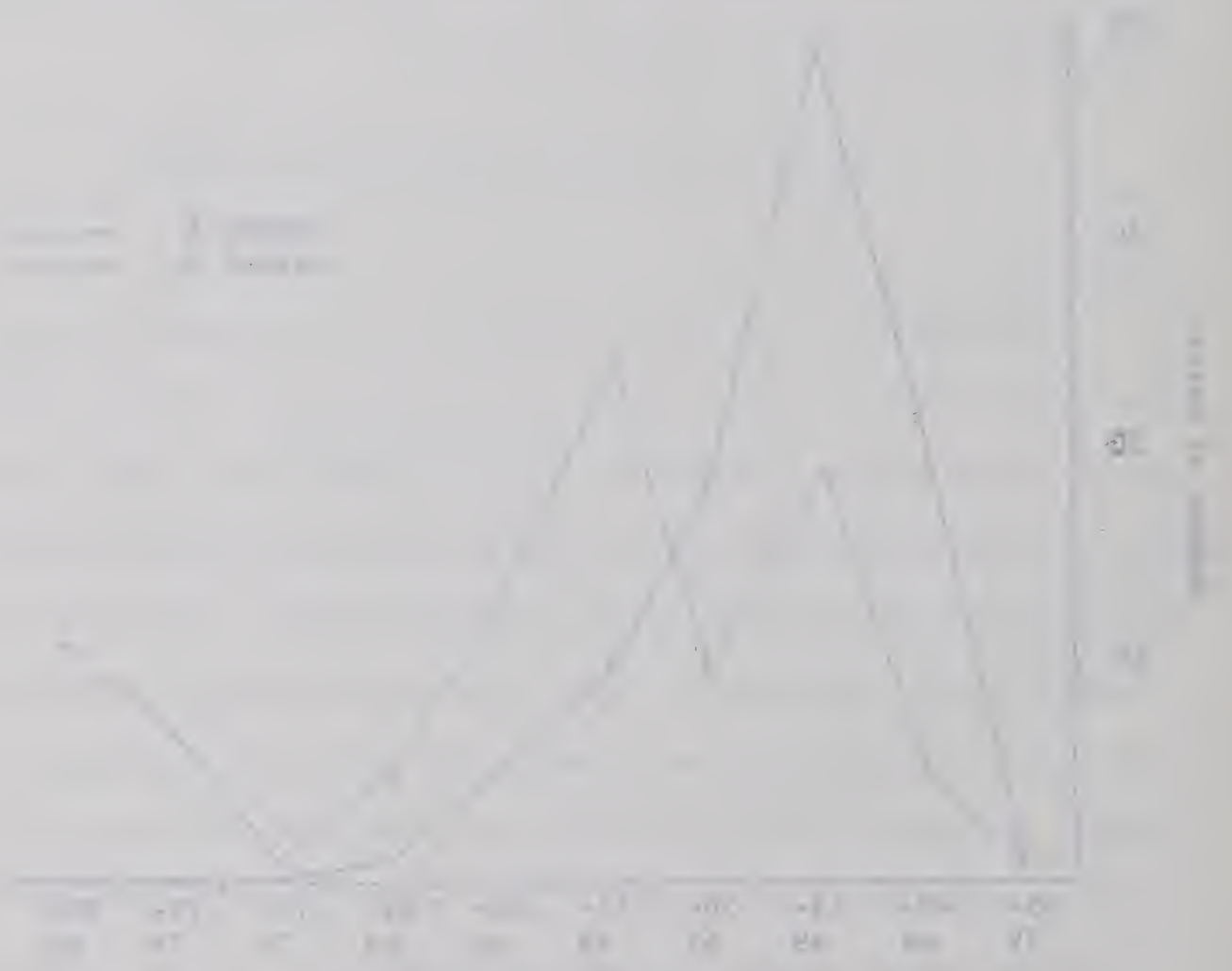


TABLE I

MEAN CHRONOLOGICAL AGE AND INTELLIGENCE FOR THE SAMPLE

Subjects	Means	
	Chronological Age	Intelligence Quotient
Grade One (N=32)	6.80	106.16
Grade Two (N=32)	7.81	103.22
Grade Three (N=32)	8.87	100.47
Grade Four (N=32)	9.83	115.00
Grade Five (N=32)	10.93	111.97
Grade Six (N=32)	11.73	119.34

It consists of three subtests, each designed to measure a specific aspect of the child's understanding of time duration.

Results of Subtest 1 - Comparisons of Duration

This subtest was designed to measure the child's understanding of verbal expressions of comparisons of duration. Ten items requiring an "either-or" response were presented to the subjects and their responses were recorded. In Table II, the number of correct responses for each item of this subtest at each grade level is presented, along with overall percentages of the subjects who provided correct responses for each item.

It will be noticed that performance on this subtest as a whole, tends to improve with each successive grade. The slightly higher performance observed at the grade four level is probably due to sampling differences.

Difficulty levels, based on the percentages of the subjects who provided correct responses for each item, ranged from 57.2 to 95.8. Items one, three and eight were easily handled but items four, five and nine were much more difficult, even for the grade six subjects. Examination of the items provides an explanation for these different levels of difficulty. Items one and eight involve comparisons of intervals which differ greatly and are therefore more easily seen. In each case, one interval is at least six times greater than the other. In item three, the subjects probably tended to give the correct answer because of some general idea that the night, when they are asleep, is a "long time" and must be longer than any isolated part of the day. It is likely that items five and nine were found difficult because in each, a mental calculation was

TABLE II

RESULTS OF SUBTEST 1 - COMPARISONS OF DURATION

Grade Level	Number of correct responses per item										Total
	Test Items										
	1	2	3	4	5	6	7	8	9	10	
1	24	24	28	19	16	19	25	24	16	18	213
2	32	27	27	24	21	20	24	30	14	14	233
3	32	26	30	17	17	24	28	32	18	19	243
4	32	25	32	23	24	29	29	31	15	28	268
5	32	22	31	24	19	31	32	32	19	30	272
6	32	27	31	24	27	32	31	32	28	32	296
Total	184	151	179	131	124	155	169	181	110	141	
Percentage of sample Correct	95.8	78.6	93.2	68.2	64.5	80.7	88.0	94.2	57.2	73.4	

Note: Maximum possible number of correct answers for each item = 32

necessary before a comparison could be made. Item four was probably found difficult because it required, to some extent, a knowledge of the order of months.

Results of Subtest 2 - Graphic Comparisons of Duration

This subtest was designed to measure the ability of children to distinguish different durations of time when the questions were presented in graphic form. It consisted of ten items in which the child had to select either the "longer" or "shorter" of two column graphs to indicate his answer. The information sought in the questions was essentially the same as that sought in the items of Subtest 1 but the method of response required was different. The results of Subtest 2 are presented in Table III.

It will be noted that a similar pattern of difficulty exists among the items of the two subtests. This is to be expected in view of the similarity of the information contained in the items of each test. Items one, three and eight were again found to be the easiest while items four, five and nine were the most difficult. It is logical to assume that the reasons for these different difficulty levels are the same as those for the differences in Subtest 1.

It is interesting to note that there is a very high correlation between the difficulty levels of the items of Subtest 1 and Subtest 2, as indicated by the percentage of the sample providing correct responses for each item. When the items are ranked from easiest to most difficult, the following order is observed:

TABLE III

RESULTS OF SUBTEST 2 - GRAPHIC COMPARISONS OF DURATION

Grade Level	Number of correct responses per item										Total
	Test Items										
	1	2	3	4	5	6	7	8	9	10	
1	18	22	17	12	17	15	23	18	8	18	168
2	30	23	25	16	19	19	23	27	14	16	212
3	32	27	25	22	22	26	25	29	15	24	247
4	32	26	32	20	25	28	27	29	15	24	258
5	31	25	31	24	23	28	30	32	20	27	271
6	32	27	30	29	30	30	31	32	27	29	297
Total	175	150	160	123	136	146	159	167	99	138	
Percentage of sample Correct	91.1	78.1	83.3	64.0	70.8	76.0	82.8	86.9	51.4	71.8	

Note: Maximum possible number of correct answers for each item = 32

Subtest 1	Subtest 2
1	1
8	8
3	3
7	7
6	2
2	6
10	10
4	5
5	4
9	9

The Spearman rank coefficient of the correlation of these two sets of scores is .97.

Results of Subtest 3 - Measures of Duration

Subtest 3 was designed to measure the child's ability to use general and specific measures of duration. It contained ten items for which the child had to provide a definite measure of some sort. This subtest differed from the others in that the responses required were not of the "either-or" type. Results of this subtest, when marked on the "precision" scale, are presented in Table IV.

It will be noticed immediately that the number of correct responses to items of this subtest is much lower than in the other subtests. In large measure, this can be explained in terms of the types of responses required. In the first two subtests, the factor of guessing could inflate the child's score wheras on Subtest 3, the chances of the child guessing the "precise" answer are much more limited. It should be noted that performance on Subtest 3 tends to improve consistently with each grade.

The difficulty level of items in this subtest ranged from 18.2 to

TABLE IV

RESULTS OF SUBTEST 3 - MEASURES OF DURATION

Grade Level	Number of correct responses per item										Total
	Test Items										
	1	2	3	4	5	6	7	8	9	10	
1	2	3	6	1	0	0	1	6	0	3	22
2	2	12	16	8	8	6	1	10	4	3	70
3	8	10	23	7	5	8	8	28	6	11	114
4	12	18	25	2	19	5	12	30	4	13	140
5	17	19	26	14	10	10	14	31	8	15	164
6	24	26	31	9	20	12	17	30	13	17	199
Total	65	88	127	41	62	41	53	135	35	62	
Percentage of sample Correct	33.8	45.8	66.1	21.3	32.2	21.3	27.6	70.3	18.2	32.2	

Note: Maximum possible number of correct answers for each item = 32

70.3. Items three and eight, by comparison with the other items, were easy. The reason for this probably lies in the fact that the "precise" responses are learned responses. The child has learned that he sleeps for eight hours or ten hours or twelve hours and that the summer holiday lasts for two months. It is possible that he could give these responses without being really aware of the times involved. Items four, six and nine were found to be very difficult. Examination of these items reveals that the child could not give a precise response to them without a knowledge of the order of the months of the year. This was probably the biggest single factor contributing to the difficulty of these items. It is perhaps surprising that only one-third of the sample knew that the time out of school at lunch time was one-and-a-half hours. The most common response was "one hour" but this could not be accepted as a precise answer. It may be that the response of "one hour" was an incorrect, learned response derived from the common expressions of "noon hour" and "lunch hour".

II. OBSERVATIONS BASED ON THE TESTING SITUATION

The testing situation was not envisaged as one in which clinical methods of observation and interview would play a major role. However, some observations made during the individual testing sessions are included here because it is felt that they give some indication of the ways in which the subjects approached the problems presented to them in the various subtests.

Subtest 1 - Comparisons of Duration

In general, items of Subtest 1 seemed to give the subjects less difficulty than the items of the other subtests. Responses for most items were made quickly and without hesitation. However, items four, six and nine appeared more difficult than the others and in a large number of cases, especially in the upper grades, it was obvious that to answer these items, the subjects were mentally counting the months between the events. In some cases, fingers were used in this counting. This type of behaviour appeared as early as grade two and was fairly widespread from grade four onwards. It was generally confined to the three items mentioned but it did occur in some other items. In the less difficult items, it appeared that the responses were given without recourse to mental reckoning of the times involved. The children simply "knew" that one event happened a longer time or a shorter time ago than another and they didn't have to calculate the intervals involved. Items one and eight provided good examples of this type of behaviour.

Subtest 2 - Graphic Comparisons of Duration

Again, items in this subtest were generally well handled. The trial question was apparently sufficient to show the subjects how the items should be answered and there was virtually no misunderstanding of what was required. Because each of the items was, in effect, repeating the previous question in a different form, they were usually handled quickly and with little hesitation. Some children, especially in the lower grades, exhibited what seemed to be obvious signs of guessing. They would hold their fingers above the page, look to the examiner for some sort of hint or encouragement

and then suddenly point to one of the columns and say "this one?". This type of behaviour had almost completely disappeared by grade four. A further indication of guessing was evident in the lower grades. Many children who gave the correct response to the previous item of Subtest 1 would give the incorrect response for the associated item of Subtest 2 and vice versa. Once again, this tendency became less marked in each successive grade and from grade four onwards, a higher correlation between the responses to associated items on the two subtests was evident. If the response to the item on Subtest 1 was incorrect, it was most likely that the response to the following item on Subtest 2 would also be incorrect, and vice versa. Table V provides a summary of the number of occasions when contradictory answers for associated items on Subtests 1 and 2 were given, at each grade level.

Subtest 3 - Measures of Duration

The items of this subtest appeared to give many children considerable difficulty and responses were often slow and hesitant. This difficulty was no doubt due to the fact that mental calculations had to be made before an answer could be given. Counting on fingers and even counting aloud, were fairly common from grade three onwards. Some children in the early grades found it impossible to give an answer to any of the ten items and as each was presented, they could only say, "I don't know". Those items which were attempted by the younger subjects were often answered in very general and vague terms such as "till morning" and "forty hundred years". This type of response was most prevalent in grade one and, to a lesser extent, grade two, but by grade three it was common to receive quite

TABLE V

NUMBER OF OCCASIONS WHEN CONTRADICTORY RESPONSES WERE GIVEN FOR ASSOCIATED ITEMS ON SUBTEST 1 AND SUBTEST 2

Grade Level	Number of Occasions
1	101
2	71
3	63
4	36
5	31
6	20

specific, although not always precise or acceptable, measures. In grades five and six, the difficulty of items of this subtest was more clearly seen. Children in these grades answered most of the items of the first two subtests with very little hesitation but often required up to half a minute to respond to some of the Subtest 3 items.

III. THE STATISTICAL ANALYSES OF THE RESULTS

Throughout this section of the report, reference will be made at times to the intercorrelations found to exist between the variables used in the study. For easy overall reference, all of these intercorrelations are contained in Table VI. In all of the analyses conducted, the .05 level of significance has been adopted.

An Analysis of the Test

The internal consistency of each of the three subtests was determined by computer analysis. Measures of reliability for each subtest, calculated by the Kuder-Richardson 20 formula, are presented in Table VII. This formula provides an indication of the extent to which the distribution of the sample on each item parallels the distribution of the sample on the whole test, or more simply, the extent to which each item measures what the whole test measures.

It will be seen that Subtest 3, the instrument used to assess the child's ability to use measures of duration, is the most reliable of the three subtests. Subtest 1, used to measure the child's understanding of verbal comparisons of duration, has low reliability in relation to the other tests. This low reliability would seem to indicate that, despite the

TABLE VI

INTERCORRELATIONS OF ALL VARIABLES

	Sex	Grade	Age	S.E.S.	Subtest 1	Subtest 2	Combined comparisons	Subtest 3	Full measures
Intelligence	-.014	.356	.303	.274	.531	.450	.519	.493	.487
Sex	-	.000	-.002	-.162	.009	-.002	.003	.103	.073
Grade placement		-	.975	.039	.520	.610	.614	.758	.781
Chronological age			-	.007	.502	.605	.599	.736	.767
Socio-economic status				-	.223	.169	.206	.136	.163
Subtest 1					-	.740	.915	.612	.644
Subtest 2						-	.948	.652	.713
Combined comparisons							-	.679	.731
Subtest 3								-	.959
Full measures									-

TABLE VII

KUDER-RICHARDSON RELIABILITY COEFFICIENTS FOR SUBTESTS OF THE BATTERY

Subtest	Reliability Coefficient
1	.45
2	.60
3	.67

revisions made in the subtest as a result of the pilot study, the subjects found some of the questions difficult and confusing and were not sure of the type of information required. In addition, guessing, particularly in the lower grades, could be a significant contributing factor to this low reliability.

As the items of Subtest 2 were very similar in content to the items of Subtest 1, it is difficult to see why Subtest 2 should be considerably more reliable than Subtest 1. It could be argued perhaps that the subjects found the graphic representations of the data less confusing than the verbal statements of the same data.

In an effort to determine whether or not the three subtests were measuring related aspects of the concept of duration, intercorrelations of performance on the subtests were found. These intercorrelations are presented in Table VIII. It will be noted that relatively high positive correlations exist between performance on all three subtests. It is not surprising to find that the highest correlation exists between Subtest 1 and Subtest 2. The information contained in the items of these two subtests was essentially the same and the reasoning processes required of the subjects were very similar.

The correlations obtained are considered as sufficient justification for believing that the subtests all measure closely connected abilities. There appears to be no evidence to contradict the assumption that they do in fact measure various aspects of the child's understanding of duration.

Analysis of the Factors Influencing Understanding of Duration

This section presents the results of that part of the study

TABLE VIII

INTERCORRELATIONS OF PERFORMANCE

ON THE SUBTESTS OF THE BATTERY

	Subtest 2	Subtest 3
Subtest 1	.74	.61
Subtest 2		.65

Note: These correlations are based on "restricted" scores for Subtest 3.

concerned with assessing the factors which influence the child's understanding of the various aspects of duration and includes a description of the procedures used for this purpose.

Intercorrelations were found between scores on the subtests and the variables of sex, socio-economic status, intelligence, chronological age and grade placement. If a significant correlation was found to exist for any one variable, multiple linear regression techniques were used to assess the contribution of this variable towards the prediction of the subtest scores in the presence of the other variables.

Each question posed by the study will now be considered in turn by reference to these statistical procedures.

Question 1

Is there any significant relationship between sex and the ability to understand comparisons and measures of duration?

A study of Table IX reveals that there is no significant correlation between sex and scores on any of the subtests. It is therefore concluded that sex is not a significant factor in predicting scores on these tests.

Question 2

Is there any significant relationship between socio-economic status and the ability to understand comparisons and measures of duration?

Table X presents the correlations between the subjects' scores on the three subtests and their socio-economic ratings as determined by the Blishen Occupational Class Scale.

It will be noticed that significant correlations exist for all three

TABLE IX

CORRELATIONS OF TEST SCORES WITH SEX

Score	Correlation	Significance
Comparisons	.009	Not significant
Graphic Comparisons	-.002	Not significant
Measures	.073	Not significant

Note: A correlation of .150 is significant at the .05 level.

TABLE X

CORRELATIONS OF TEST SCORES WITH

SOCIO-ECONOMIC STATUS

Score	Correlation	Significance
Comparisons	.223	Significant
Graphic Comparisons	.169	Significant
Measures	.163	Significant

Note: A correlation of .150 is significant at the .05 level.

subtests although the correlations are not high. This would indicate that there is a small but significant relationship between the child's socio-economic status and his ability to understand comparisons and measures of duration.

Table XI shows that when the effects of the other contributing variables are considered, socio-economic status is a significant predictor of performance on Subtests 1 and 3 but not on Subtest 2.

It is concluded therefore that a significant though small relationship exists between socio-economic status and ability to understand comparisons and measures of duration and that socio-economic status alone is not a significant predictor of ability to understand graphic comparisons of duration.

Question 3

Is there any significant relationship between intelligence and the ability to understand comparisons and measures of duration?

The correlations between intelligence ratings and scores on the three subtests are listed in Table XII. It will be noted that all three correlations are significant. As well, it may be seen from Table XIII that when the effects of the other variables are considered, intelligence is a highly significant predictor of performance on all three subtests.

From these figures it is concluded that intelligence is very closely related to ability to understand comparisons and measures of duration.

Question 4

Is there any significant relationship between chronological age and

TABLE XI

THE CONTRIBUTION OF SOCIO-ECONOMIC STATUS

TO THE PREDICTION OF SUBTEST SCORES

IN THE PRESENCE OF OTHER VARIABLES

Subtest	F Ratio
Comparisons	4.315
Graphic Comparisons	2.912
Measures	6.002

Note: $F(1,182)_{.05} = 3.90$

TABLE XII

CORRELATIONS OF TEST SCORES WITH INTELLIGENCE

Score	Correlation	Significance
Comparisons	.531	Significant
Graphic Comparisons	.450	Significant
Measures	.487	Significant

Note: A correlation of .150 is significant at the .05 level.

TABLE XIII

THE CONTRIBUTION OF INTELLIGENCE TO THE PREDICTION OF SUBTEST SCORES IN THE PRESENCE OF OTHER VARIABLES

Subtest	F Ratio
Comparisons	37.458
Graphic Comparisons	26.638
Measures	42.064

Note: $F(1,182)_{.05} = 3.90$

the ability to understand comparisons and measures of duration?

Table XIV shows that significant correlations exist between the chronological age of the subjects and their scores on all three subtests. These correlations indicate that as the children become older, they are better able to understand comparisons and measures of duration.

When the effects of the other contributing variables are considered however, it is found that chronological age is not a significant predictor of performance on the three subtests. (See Table XV). This is no doubt largely due to the high correlation of .97 between chronological age and grade placement. When the contribution of chronological age to prediction is considered in the presence of grade alone, the extent of this contribution, over and above the contribution of knowledge of grade placement, is not significant. (See Table XVI).

Because of this, it is misleading to say that chronological age is not a significant predictor of performance on the three subtests. If knowledge of grade placement were not available then chronological age could certainly be a useful predictor of performance.

Question 5

Is there any significant relationship between grade placement and the ability to understand comparisons and measures of duration?

The correlations between the grade placement of the subjects and their scores on the three subtests are presented in Table XVII. It will be noticed that all three correlations are significant. It may therefore be assumed that the child's ability to understand comparisons and measures of duration is closely linked to his past instruction and years of schooling.

TABLE XIV

CORRELATION OF TEST SCORES

WITH CHRONOLOGICAL AGE

Score	Correlation	Significance
Comparisons	.502	Significant
Graphic Comparisons	.605	Significant
Measures	.767	Significant

Note: A correlation of .150 is significant at the .05 level.

TABLE XV

THE CONTRIBUTION OF CHRONOLOGICAL AGE

TO THE PREDICTION OF SUBTEST

SCORES IN THE PRESENCE OF OTHER VARIABLES

Subtest	F Ratio
Comparisons	1.501
Graphic Comparisons	2.036
Measures	2.888

Note: $F(1,182)_{.05} = 3.90$

TABLE XVI

THE CONTRIBUTION OF CHRONOLOGICAL AGE

TO THE PREDICTION OF SUBTEST

SCORES IN THE PRESENCE OF GRADE PLACEMENT ALONE

Subtest	F Ratio
Comparisons	.075
Graphic Comparisons	.020
Measures	.249

Note: $F(1,186)_{.05} = 3.90$

TABLE XVII

CORRELATIONS OF TEST SCORES WITH

GRADE PLACEMENT

Score	Correlation	Significance
Comparisons	.520	Significant
Graphic Comparisons	.610	Significant
Measures	.781	Significant

Note: A correlation of .150 is significant at the .05 level.

Table XVIII shows that when the effects of all the other contributing variables are considered, grade placement is a significant predictor of performance on the graphic comparisons subtest and the measures subtest. It will be noted however that grade placement is not a significant predictor of performance on the verbal comparisons subtest.

When the contribution of grade placement to prediction of performance on Subtests 2 and 3 is considered in the presence of chronological age alone, the extent of this contribution, over and above the contribution of knowledge of chronological age, is significant. (See Table XIX). It is assumed that the information which grade placement contributes over and above that contributed by chronological age, is connected in some way with the quality and extent of the child's past school instruction.

From these analyses it is concluded that knowledge of grade placement contributes to prediction of performance on Subtests 2 and 3 but not on Subtest 1.

Analysis of Developmental Stages in Understanding of Duration

This section deals with that part of the study concerned with assessing the stages by which children acquire understanding of comparisons and measures of duration. The questions posed will now be considered in turn, chiefly by reference to descriptive statistical procedures.

Question 6

Is there any significant relationship between ability to understand comparisons of duration and ability to use measures of duration?

TABLE XVIII

THE CONTRIBUTION OF GRADE PLACEMENT

TO THE PREDICTION OF SUBTEST SCORES

IN THE PRESENCE OF OTHER VARIABLES

Subtest	F Ratio
Comparisons	.929
Graphic Comparisons	3.675
Measures	8.865

Note: $F(5,182)_{.05} = 2.26$

TABLE XIX

THE CONTRIBUTION OF GRADE PLACEMENT

TO THE PREDICTION OF SUBTEST SCORES

IN THE PRESENCE OF CHRONOLOGICAL AGE ALONE

Subtest	F Ratio
Comparisons	1.449
Graphic Comparisons	2.374
Measures	3.765

Note: $F(5,186)_{.05} = 2.26$

The intercorrelations between performance on the three subtests, discussed previously in connection with the test analysis, indicate that a significant relationship does exist between ability to understand comparisons of duration and ability to use measures of duration. Correlations in the order of .60 were found between performance on each of the comparisons subtests and performance on the measures subtest. It will be remembered however, that these correlations were based on "restricted" scores for Subtest 3. By way of additional analysis, a correlation was calculated between combined comparisons scores and full measures scores. This correlation was found to be .73, indicating that there is a close relationship between overall understanding of comparisons of duration and ability to use measures of duration.

Question 7

Are measures of duration more difficult for children to understand and use than comparisons of duration?

Before an answer to this question can be attempted, it is necessary to establish a basis for legitimate comparison of the scores of the three subtests. The results of Subtests 1 and 2 may be compared without adjustment because these tests contain items which are very similar and because the number of items which the child could be expected to answer correctly, purely by guessing, is the same for each. However, any attempt to compare the results of these two subtests with the results of Subtest 3 is much more difficult. Subtest 3 contains the same number of items as each of the other subtests but because the likelihood of the child getting any of the items correct, purely by guessing, is very remote, the subtest

results cannot be directly compared with the others.

It is necessary therefore to correct the results of Subtests 1 and 2 for guessing before comparing them in any way with the results of Subtest 3. It was decided to apply a correction to the scores of each subject on each of the two subtests. Because there were only two possible choices for each item, a correct choice and an incorrect choice, the correction formula applied was

$$C_s = \frac{R - W}{1}$$

The use of this formula is considered by Gulliksen (1961) to be a legitimate procedure, under the circumstances, for estimating the number of items for which the subjects knew the answer. Table XX contains the mean raw scores for each grade on each of the three subtests and the mean corrected scores for each grade on Subtests 1 and 2. The information contained in this table is graphically presented in Figure 2.

Examination of Figure 2 reveals that with the exception of the grade one performance on Subtest 2, the means of the first two subtests are all higher than the means of Subtest 3. Assuming that the corrected means of the first two subtests can be directly compared with the means of Subtest 3, it is concluded that the items of Subtest 3 were more difficult for the children to answer than the items of the other two subtests. This conclusion is supported by the observations made by the investigator during the testing situations. In general, the subjects appeared to experience the greatest difficulty in answering the Subtest 3 items.

It will be noticed that there is almost no difference between the means of grade one subjects on the graphic comparisons and measures subtests.

TABLE XX

MEAN SCORES FOR EACH GRADE ON

THE THREE SUBTESTS

Grade Level	Subtest 1		Subtest 2		Subtest 3
	Mean Raw Score	Corrected Score Mean	Mean Raw Score	Corrected Score Mean	Mean Raw Score
1	6.62	3.25	5.28	.56	.62
2	7.25	4.50	6.37	3.19	2.09
3	7.72	5.31	7.81	5.56	3.56
4	8.47	6.94	8.06	6.19	4.41
5	8.44	6.88	8.50	6.94	5.31
6	9.25	8.44	9.28	8.63	6.22

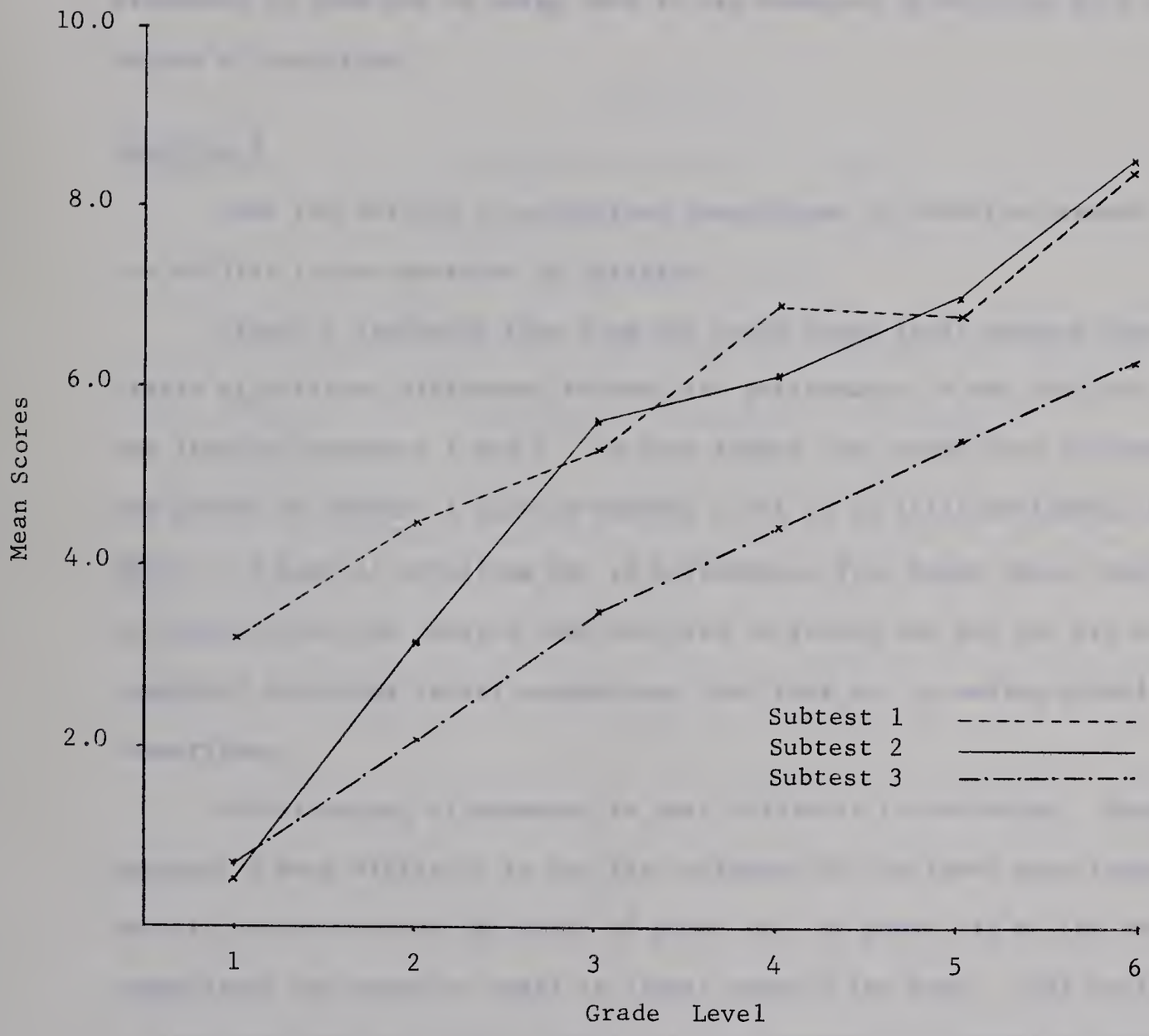
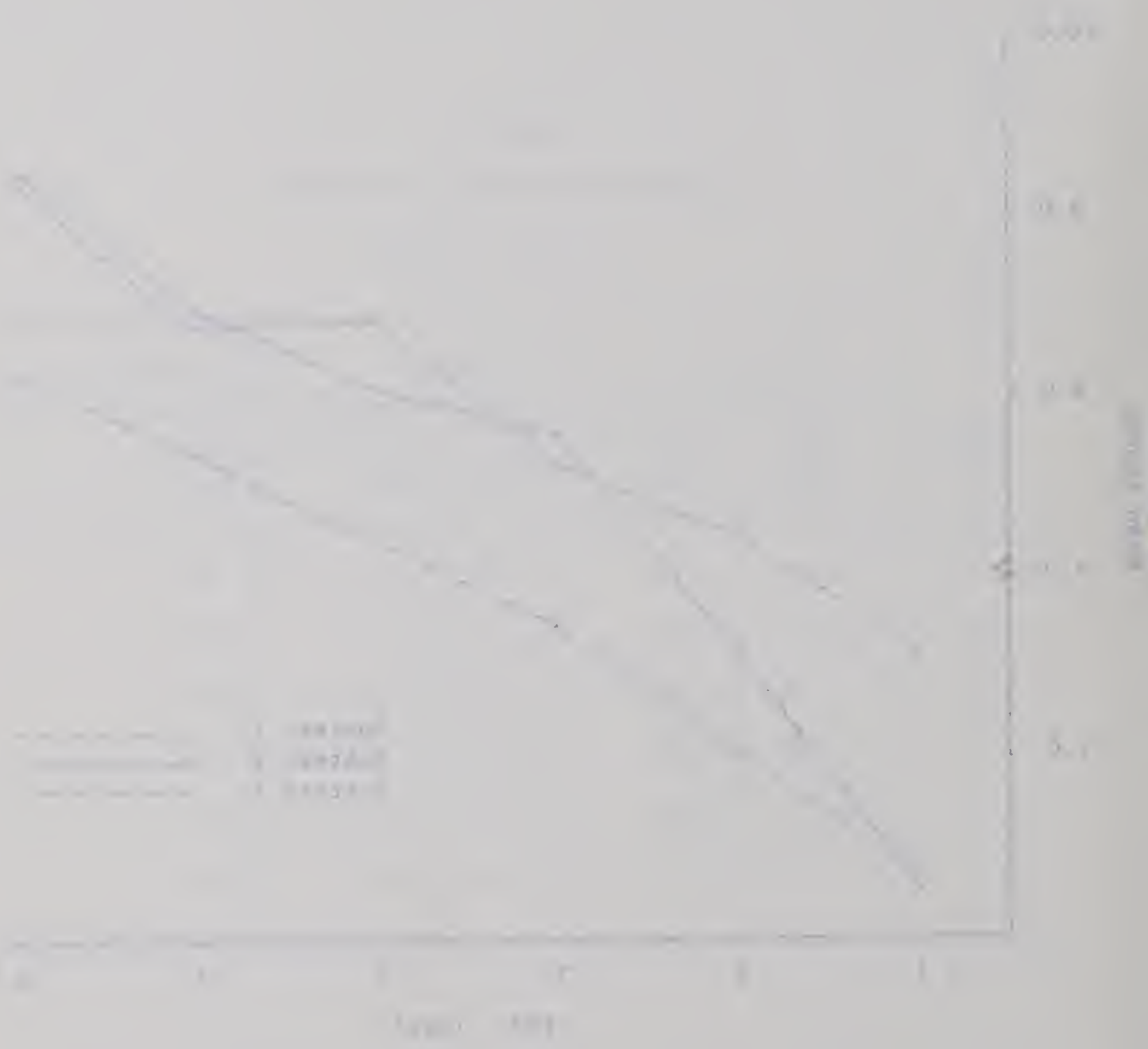


FIGURE 2

MEAN RAW SCORES FOR EACH GRADE ON SUBTEST 3

AND MEANS OF CORRECTED SCORES FOR EACH GRADE ON SUBTESTS 1 AND 2



Both means were very low. It must be concluded that the grade one children were simply incapable of understanding the graphic problems presented to them and of being able to use measures of duration with any degree of precision.

Question 8

Does the ability to understand comparisons of duration precede the ability to use measures of duration?

Figure 2 indicates that from the grade three level onwards there is little significant difference between the performance of the subjects on the items of Subtests 1 and 2. In this sample, the grade four performance was better on Subtest 1 than on Subtest 2 but it is still noticeable that there is a general levelling out of performance from grade three onwards. It appears from the results that children in grades one and two are more competent in making verbal comparisons than they are in making graphic comparisons.

Understanding of measures is more difficult to determine. They are apparently more difficult to use (as indicated by the lower mean scores) but the difference between the means of grade one and grade six on the verbal comparisons and measures tests is almost exactly the same. This would seem to indicate that the child's ability to use measures of duration increases in direct proportion to his ability to understand verbal comparisons of duration and that one ability does not necessarily precede the other.

Observations based on the response patterns of the younger subjects however, provide some evidence that verbal comparisons are understood before measures. Table XXI shows the number of children in each grade who received

TABLE XXI

THE NUMBER OF SUBJECTS IN GRADES ONE, TWO AND THREE, SCORING ZERO ON THE THREE SUBTESTS

Grade Level	Subtest 1	Subtest 2	Subtest 3
1	8	17	19
2	0	7	7
3	0	3	1

zero scores for each subtest, that is, who did not answer any of the items correctly. (For Subtests 1 and 2, a score of 5 or less was considered to be a zero score simply because the child could be expected to answer up to five items correctly by guessing). Examination of the table indicates that fewer children gained zero scores on the verbal comparisons test than on either of the other two tests. This could be taken as an indication that in the lower grades, understanding of verbal comparisons of duration precedes understanding of both graphic comparisons and measures. It will be noted that by grade three, almost all of the subjects were giving correct responses to at least some of the items of all three subtests.

From these observations, it is concluded that:

1. Understanding of verbal comparisons of duration precedes understanding of graphic comparisons of duration.

2. Ability to use measures of duration appears to be closely linked to ability to understand verbal comparisons of duration.

3. There is some evidence to suggest that in grades one and two, understanding of verbal comparisons of duration is more advanced than ability to use measures of duration.

Question 9

Is there a progressive development with age and grade in the ability to understand comparisons of duration and the ability to use measures of duration?

Figure 2 indicates that, with respect to grade, there is a progressive development of understanding of comparisons and measures of duration. The most noticeable pattern is observed in the development of the

ability to use measures of duration. This ability progresses in almost equal steps throughout the entire grade range.

The development of the ability to understand verbal comparisons follows a similar pattern except for a fluctuation at the grade four level, probably the result of sample differences. Ability to understand graphic comparisons of duration begins from a very low level in grade one and progresses rapidly until grade three. From then on, it follows closely the pattern of performance for verbal comparisons. It is interesting to note that performance on Subtests 1 and 2 shows a noticeable increase at the grade six level.

From the patterns shown in Figure 2, it is concluded that:

1. The ability to understand verbal comparisons of duration appears to progress evenly with each grade until the grade six level when an increased rate of understanding is noted. (An increase in performance observed at the grade four level is most probably an effect of the sample used).

2. The ability to understand graphic comparisons of duration begins at a low level and increases rapidly until grade three. It then follows essentially the same progression as that observed for understanding of verbal comparisons with a similar noticeable increase in understanding at the grade six level.

3. The ability to use measures of duration progresses in even stages with each grade and tends to follow the general pattern observed for understanding of verbal comparisons.

Similar patterns of development exist between chronological age

levels and performance on the three subtests. This similarity was expected because of the high correlation observed between age and grade for the sample. From these patterns, the following conclusions may be drawn.

1. The ability to understand verbal comparisons of duration appears to develop evenly with age until about age eleven when an increased rate of understanding is noted.

2. The ability to understand graphic comparisons of duration begins at a low level at age seven and increases rapidly until age nine. Its development is then similar to that of the understanding of verbal comparisons of duration and a similar increase in performance is noted at about age eleven.

3. The ability to use measures of duration progresses evenly with age and tends to follow the same pattern as that observed for understanding of verbal comparisons of duration.

Question 10

At what stage of the child's development can it be said that he can understand comparisons of duration and can use measures of duration?

This question will be answered in two parts by separate reference to the understanding of comparisons of duration and the use of measures of duration.

a. Comparisons of Duration. It was decided that a score of eight or more on Subtests 1 and 2 should be taken as an indication that the child had a satisfactory understanding of verbal and graphic comparisons. This score

was chosen because, on the basis of guessing alone, the child would have only five chances out of one hundred of answering eight or more of the items correctly. A score of eight, when corrected for guessing, is equivalent to saying that the child knew the answers to six of the ten items.

Table XXII contains the percentages of subjects in each grade who had a raw score of eight or more for each of the subtests. Examination of the table shows that verbal comparisons were better understood than graphic comparisons in grades one and two but that by grade three there was little difference between the two. It will be noticed that at the grade three level, half of the children in the sample scored eight or more on each of the subtests.

As a further analysis, it was decided to determine the number of children in each grade who scored a maximum of ten on each of the subtests. Table XXIII shows the results of this analysis. It will be seen, once again, that the grade three level was the first at which significant numbers of children gained maximum scores.

From these analyses, it is concluded that by the time children are in grade three, that is, at about age eight or nine, they have begun to understand comparisons of duration. Support for this conclusion is provided by the fact that the child's understanding of graphic comparisons is poorly developed in grades one and two. To answer the items of Subtest 2, the child could not call on a learned response. He had to rely on his understanding of the relative lengths of the time intervals involved. The poor performance on this subtest would seem to indicate that in grades one and two, the child cannot appreciate the differences between such intervals.

TABLE XXII

PERCENTAGES OF SUBJECTS IN EACH GRADE SCORING 8 OR MORE ON EACH OF SUBTESTS 1 AND 2

Grade Level	Subtest 1	Subtest 2
1	40.6%	25.0%
2	46.9%	28.1%
3	53.1%	59.4%
4	75.0%	59.4%
5	75.0%	78.1%
6	96.9%	96.9%

TABLE XXIII

NUMBER OF SUBJECTS IN EACH

GRADE WITH MAXIMUM SCORES ON

SUBTESTS 1 AND 2

Grade Level	Subtest 1	Subtest 2
1	1	0
2	1	0
3	4	5
4	7	6
5	6	7
6	15	15

This in turn suggests that his responses to the items of the other two subtests were dependent largely on guessing or on learned responses. On the basis of this reasoning, it would seem that before grade three, the child does not have a satisfactory understanding of duration.

From grade three onwards however, the child is able to understand the graphic representations of time in the items of Subtest 2. It is logical to assume therefore, that from this point onwards, understanding of comparisons of duration is possible.

Examination of the results of Subtests 1 and 2 indicates that this understanding continues to develop through grades four and five and that by the time children reach grade six, it is firmly established.

It should always be remembered however, that this pattern of development can at best, be only a guide. In the sample used, one child in grade one and another in grade two obtained the maximum possible score for the first subtest and in grade three, two children scored the maximum on both subtests. Similarly, one child in grade five had a corrected score of zero for both subtests.

b. Measures of Duration. In an attempt to determine the stages by which children master the use of measures of duration, a detailed analysis of the responses to Subtest 3 was prepared. This analysis is contained in Table XXIV. Before examining this table, some explanation is required of the response categories used in the analysis. These may best be presented in summary form.

IDK - This represents an "I don't know" response from the subject.

GENERAL - In a response of this type, no mention was made of units of time. A typical general response was "a long time".

TABLE XXIV

ANALYSIS OF RESPONSES GIVEN BY

EACH GRADE TO ITEMS ON SUBTEST 3

Grade Level	IDK	General	Specific	Acceptable	Precise	Total
1	124	47	104	23	22	320
2	44	2	143	61	70	320
3	10	0	95	91	114	320
4	1	0	80	99	140	320
5	1	0	78	77	164	320
6	0	0	41	80	199	320

SPECIFIC - A response in which a unit of time was used but which could not be considered as either "acceptable" or "precise". An example of such a response was "the summer holiday lasts for a year".

ACCEPTABLE - An acceptable response as previously defined in Chapter III.

PRECISE - A precise response as previously defined in Chapter III.

Examination of Table XXIV reveals some interesting patterns. Immediately noticeable is the frequency of the first three types of responses in grade one, particularly the "I don't know" response. It is safe to assume that grade one children have little ability to use measures of duration in any satisfactory way.

In grade two the pattern is similar but an interesting development is noticed. There is a marked decrease in the number of responses which made use of specific but unacceptable measures. Coupled with this is the virtual disappearance of general measures. This would indicate that at the grade two level the child is just beginning to understand that time can be measured using units. The number of acceptable and precise responses indicates however, that he has not mastered these measuring units and doesn't really understand what they mean.

By grade three, the child has completely discarded the general type of response and is prepared to assign specific measures to time intervals. His grasp of the measuring units he uses is still not accurate enough to indicate satisfactory understanding but it would seem that at this level, he begins to understand that conventional measuring units have to be used accurately.

At the grade four level, the child first begins to use measures of duration in a satisfactory manner. At this point, the "I don't know" response had almost completely disappeared from the sample and three-quarters of the responses given were either acceptable or precise.

As the child progresses through the grades, his understanding of the measuring units he uses becomes more refined. He is able to give progressively more and more acceptable and precise responses and fewer responses in which the units are used inaccurately. By grade six, his knowledge of measures of duration and his ability to use these measures have reached a quite satisfactory level. As will be seen from the table, almost two-thirds of the responses of the grade six children in this sample were precise.

In summary, it appears that effective use of measures of duration is not likely in grades one and two and is very doubtful even in grade three. At this level however, the child first begins to understand the conventions of time measurement and his ability to use time measures increases progressively as he passes through the upper elementary grades. Effective use of measures may be said to begin at the grade four level when, in the sample used, 75% of the measures given were either acceptable or precise. By the time the child reaches grade six, it can be concluded that his ability to use measures of duration is well established.

IV. SUMMARY OF FINDINGS

The major findings of this study may be briefly summarised as follows:

1. No significant relationship exists between sex and the ability to understand comparisons and measures of duration.

2. A significant relationship exists between socio-economic status and the ability to understand comparisons and measures of duration but socio-economic status alone is not a significant predictor of ability to understand graphic comparisons of duration.

3. A highly significant relationship exists between intelligence and the ability to understand comparisons and measures of duration.

4. A significant relationship exists between chronological age and the ability to understand comparisons and measures of duration but knowledge of chronological age does not contribute significantly more to prediction of performance than does knowledge of grade placement.

5. A significant relationship exists between grade placement and the ability to understand comparisons and measures of duration but grade placement alone is not a significant predictor of ability to understand verbal comparisons of duration.

6. A significant relationship exists between the ability to understand comparisons of duration and the ability to use measures of duration. There is a suggestion that the child's ability to use measures of duration increases in proportion to his ability to understand verbal comparisons of duration.

7. Understanding of verbal comparisons of duration precedes understanding of graphic comparisons of duration in grades one and two. From grade three onwards, little difference in the understanding of either is observed.

8. Questions involving measures of duration are more difficult for children to answer than questions involving comparisons of duration.

9. There is a progressive development with grade and age in the ability to understand comparisons of duration and the ability to use measures of duration.

10. A noticeable improvement in the ability to understand comparisons and measures of duration is apparent at the grade six level when the child is from eleven to twelve years of age.

11. Understanding of comparisons of duration appears to be established at the grade three level when the child is from eight to nine years of age.

12. The first satisfactory use of measures of duration appears at the grade four level when the child is from nine to ten years of age. At this level, 75% of the measures used are either precise or acceptable as estimates, by normal adult standards.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

I. PURPOSE OF THE STUDY

The purpose of this study was to investigate the factors which influence the child's understanding of time duration and the stages by which such understanding is acquired. The study was undertaken in the hope that it might provide an indication of the most appropriate levels of the elementary school for instruction in those aspects of the social studies which depend heavily on the concept of the duration of time.

The development of the concept of duration was examined by means of a battery of tests designed by the investigator. This battery consisted of three separate subtests, each designed to measure a specific aspect of the concept. The first subtest measured understanding of verbal comparisons of duration; the second measured understanding of graphic comparisons of duration and the third measured ability to use measures of duration.

The battery of tests was administered by the investigator to a sample of one hundred and ninety-two children, selected at random from two elementary schools within the public school system of Edmonton, Alberta, Canada. This sample was made up of sixteen males and sixteen females from each grade, one to six inclusive, a total of thirty-two subjects from each grade. The ages of these children ranged from six years four months to thirteen years two months. The intelligence range,

taken from available school records of Detroit Beginning First Grade scores, was from seventy-seven to one hundred and forty. For the sample, the ratings of socio-economic status, as measured by the Blishen Occupational Class Scale, ranged from 37.5 to 82.5.

The battery of tests was administered to each subject in an individual testing situation. Every effort was made to avoid interruptions and to ensure that the testing situation did not vary from one subject to another. The testing program was conducted during the last two weeks of April, 1967.

Certain limitations of the study must be considered in any interpretation of the results and conclusions which follow. A fundamental assumption of the study is that the tests used were valid measures of the ability of children to understand comparisons of duration and to use measures of duration. As well, it is assumed that the concept of duration can be isolated from other aspects of time sense and can be studied separately. It should be remembered that the study was based on a limited sample of urban school children and that no attempt was made to account for the effects of past instruction in the measurement of time and practice in the solving of problems associated with time. Finally, it is assumed that if the child shows understanding of the time intervals involved between events <u>within</u> his own experience, then instruction involving intervals of past time, <u>beyond</u> his experience, can be meaningful to him. All three subtests measured only understanding of intervals between events within the child's experience.

The test was scored and the results were analysed during May, 1967.

The statistical analyses were carried out through the Computing Services of the University of Alberta, by means of an IBM 7040 Computer. In the analyses, answers were sought to the following questions.

1. Is there any significant relationship between sex and the ability to understand comparisons and measures of duration?

2. Is there any significant relationship between socio-economic status and the ability to understand comparisons and measures of duration?

3. Is there any significant relationship between intelligence and the ability to understand comparisons and measures of duration?

4. Is there any significant relationship between chronological age and the ability to understand comparisons and measures of duration?

5. Is there any significant relationship between grade placement and the ability to understand comparisons and measures of duration?

6. Is there any significant relationship between ability to understand comparisons of duration and ability to use measures of duration?

7. Are measures of duration more difficult for children to understand and use than comparisons of duration?

8. Does the ability to understand comparisons of duration precede the ability to use measures of duration?

9. Is there a progressive development with age and grade in the ability to understand comparisons and measures of duration?

10. At what stage of the child's development can it be said that he can understand comparisons of duration and can use measures of duration?

II. SUMMARY OF RESULTS AND CONCLUSIONS

On the basis of the findings of this study, the following conclusions may be drawn.

1. No significant relationship exists between sex and the ability to understand comparisons and measures of duration. This finding supports an earlier one by Friedman (1944) who found that sex is not a significant factor in the child's understanding of time terms, indefinite expressions of time, time lines and chronological order.

2. A significant relationship exists between socio-economic status and the ability to understand comparisons and measures of duration but socio-economic status alone is not a significant predictor of ability to understand graphic comparisons of duration. No previous study has reported socio-economic status as a significant factor in the child's understanding of concepts of time.

3. A highly significant relationship exists between intelligence and the ability to understand comparisons and measures of duration. This finding is in accord with the findings of the majority of previous studies devoted to the child's understanding of time.

4. A significant relationship exists between chronological age and the ability to understand comparisons and measures of duration but knowledge of chronological age does not contribute significantly more to prediction of performance if grade placement is known. Chronological age may be used as a predictor of the child's ability to understand comparisons and measures of duration but the level of prediction would

not be as precise as that provided by either intelligence or grade placement.

5. A significant relationship exists between grade placement and the ability to understand comparisons and measures of duration but grade placement alone does not contribute significantly to prediction of ability to understand verbal comparisons of duration. This indicates that the instruction received by the child and the extent of his formal schooling have some influence on his understanding of comparisons and measures of duration. This influence however, is not significant with respect to verbal comparisons of duration.

6. The child's ability to understand comparisons of duration is closely linked to his ability to use measures of duration. The responses of the subjects in this study suggested that ability to use measures of duration increases in proportion to ability to understand verbal comparisons of duration.

7. In grades one and two, the child has a better understanding of verbal comparisons than graphic comparisons but from grade three onwards there is little difference in the understanding of either.

8. Questions involving measures of duration are more difficult for children to answer than questions involving comparisons of duration. This is probably due to the mental calculations which must be made before a measure can be given.

9. There is a progressive development with age and grade in the ability to understand comparisons and measures of duration.

10. At the sixth grade level, when the child is from eleven to

twelve years of age, there is a noticeable improvement in ability to understand comparisons and measures of duration. Similar improvements in understanding of other aspects of the time concept were noted at this level by Oakden and Sturt (1922) and Uka (1956).

11. Understanding of comparisons of duration appears to be established at the grade three level when the child is from eight to nine years of age. Piaget's finding, that the child can understand comparisons of duration at about age eight is therefore substantiated.

12. Ability to use measures of duration appears to be established at the grade four level when 75% of the measures used are either precise or acceptable as estimates, by normal adult standards. This later development of the ability to use measures of duration has also been pointed out by Piaget who claims that such ability does not develop until the child has mastered the allied concepts of duration and seriation. Piaget does not give an age level at which the ability to use measures of duration is established but he concludes that this level is reached "during the stage of concrete operations" from about age eight to twelve. The conclusion that ability to use measures of duration is established at the grade four level seems to contradict an earlier study by Oakden and Sturt (1922), who found that such ability is not satisfactorily developed until age twelve. It must be remembered however, that the Oakden and Sturt study used only four questions involving measures of duration and two of these, involving very small periods of time, were not directly comparable to those used in the present study. It is therefore difficult to draw meaningful comparisons between the two studies.

III. IMPLICATIONS

Some suggestions for the planning and teaching of social studies courses in the elementary school arise from the findings of this study.

1. Any social studies program which emphasises time patterns and relationships should take into consideration the levels of conceptual development which are characteristic of the children for whom the program is intended.

2. This study has shown that ability to understand comparisons of duration is established at the grade three level. While it has been argued that instruction involving time concepts can be initiated as early as the kindergarten level (Robison and Spodek, 1965), it is doubtful if such early instruction is meaningful enough to the child to be beneficial.

3. Simple graphic representations of problems of time duration are not understood by most children in grades one and two. It is therefore likely that the use of time lines has dubious value in these grades. The results of this study suggest that time lines should be considered as an effective tool in the teaching of social studies, only from the grade three level onwards.

4. From grade three onwards, a close relationship exists between ability to understand comparisons of duration and ability to use measures of duration. This suggests that whenever possible, time intervals should be expressed in terms of both of these abilities. We may, for instance, tell the child that the United Nations Organisation was established a

little over twenty years ago. This statement would be more meaningful if the period of twenty years could be compared with some other period of time with which the child is familiar. It could be said, for example, that the United Nations Organisation has been in operation for "twice as long as you have been living" or that it was established when "most of your fathers were about your age". Such expressions would have merit at all levels of the elementary school.

5. According to the results of this study, measures of duration are more difficult for children to master than comparisons of duration. This is no doubt largely due to the mental calculations which must be made before measures can be given. These calculations, in turn, cannot be made unless the child has developed an understanding of the times involved in the conventional measures applied to time, such as hours, days, weeks, months and years. Without this understanding, it is impossible for the child to benefit fully from instruction which involves the use of dates. As the ability to use measures of duration was first found to reach satisfactory proportions at the grade four level, the use of dates to provide any form of reference system does not seem justifiable before this level. It must be remembered however, that even at the grade four level, 25% of the children cannot use measures of duration satisfactorily. For this reason, dates used in grade four should be few and simple or at least, be richly supplied with data for comparison.

6. Understanding of all aspects of duration appears to be firmly established at the grade six level. It will be remembered that in this

grade, noticeable improvements in understanding of comparisons of duration were observed and measures could be used with precision. It is only at the grade six level therefore that it can be assumed that the child is able to understand, with any degree of sophistication, the complex periods of time involved in the distant past. While topics of ancient history are sometimes taught in earlier grades, it would appear that such topics would have more meaning for the child if they were not introduced until grade six.

7. The results of the study indicate that even in the upper elementary grades, children have a tendency to approximate intervals when assigning measures to them. This finding suggests that educators should always take a realistic attitude towards what can be expected from elementary school children. Precise measures of duration should be perhaps neither expected nor desired from children below the fourth grade in the elementary school.

8. The link observed between socio-economic status and the child's ability to understand comparisons and measures of duration seems to reflect the influence of books and discussions and the wider range of experiences, which are all presumed to be features of homes of higher socio-economic standing. This finding strengthens the argument that full use should be made in social studies lessons of such instructional techniques as book reviews, project work, films and field trips so that events and situations are made as meaningful to the child as possible. These techniques are perhaps particularly relevant in programs designed specifically for underprivileged children.

9. The child's intelligence should always be considered in assessing his understanding of time intervals, and hence, the social studies work which he will be able to handle most effectively. It is entirely possible that an intelligent third grade class might be able to understand certain units of work involving time durations equally as well as a normal fourth grade class. As well, understanding of duration varies greatly from one individual to another. The teacher must guard against assuming that all children in her class have reached the same levels of understanding of time.

10. The study has shown that many children, especially in the lower grades, make frequent use of "learned responses" when giving measures of duration. Educators should always bear in mind that while a child may be able to quote a date or indicate the length of an interval of time, this does not necessarily mean that he understands the time involved.

IV. SUGGESTIONS FOR FURTHER RESEARCH

Some suggestions for further research, arising out of this study, are presented below.

1. Intelligence was found to be a highly significant predictor of the child's ability to understand comparisons and measures of duration. Further research into the interaction effects of age and intelligence might prove to be useful. Such research would seek to discover if young, intelligent children do in fact understand duration as well as older, less intelligent children.

2. This study found that socio-economic status is a significant factor in the child's understanding of duration. The contribution of socio-economic status to the understanding of other aspects of the concept of time deserves further investigation.

3. Further research into the contribution of past instruction and experience to the understanding of time concepts would be profitable. The child's mathematical ability, his understanding of the clock and the calendar, his mastery of time measuring units and perhaps even his reading ability could all be worthy of consideration in this context.

4. This study has concluded that comparisons of duration are understood at the grade three level and that measures of duration are satisfactorily used at the grade four level. Further research might indicate if specific instruction in comparisons and measures of duration in the early grades will lead to earlier understanding. It will be remembered that for other aspects of the concept of time, such instruction has produced accelerated understanding.

5. Research is needed to clarify the whole question of the use of time lines as a method of teaching time relationships in the elementary school.

6. This study found that graphic representations of time intervals were not satisfactorily understood by children in grades one and two. This finding suggests that further investigation of the primary school child's understanding of graphic materials in general, could prove to be worthwhile.

7. In this study, a noticeable improvement in understanding of

duration was observed at the grade six level. Similar improvements were noted at this level by Oakden and Sturt (1922) and Uka (1956) in their investigations of other aspects of the time concept. The reason for this improvement is not clear and provides interesting possibilities for further research.

BIBLIOGRAPHY

BIBLIOGRAPHY

Ames, L.B. "The Development of the Sense of Time in the Young Child," Pedagogical Seminary and Journal of Genetic Psychology, LXVIII (April, 1946), pp. 97-125.

Arnsdorf, V.E. "An Investigation of the Teaching of Chronology in the Sixth Grade," Journal of Experimental Education, XXIX (March, 1961), pp. 307-313.

Becker, J.W. and Gontner, K.L. "First Grade Children's Understanding of Time Concepts," Childhood Education, XLII (February, 1966), pp. 389-392.

Blishen, B.R. "The Construction and Use of an Occupational Class Scale," Canadian Society, Sociological Perspectives, B.R.Blishen (ed.) New York: Macmillan (Free Press of Glencoe), 1961.

Bradley, N.C. "The Growth of the Knowledge of Time in Children of School Age," British Journal of Psychology, XXXVIII (1947), pp. 67-78.

Chase, W.L. "American History in the Middle Grades," Interpreting and Teaching American History, Thirty-first Yearbook, National Council for the Social Studies, Washington, D.C.: NCSS, 1961.

Davis, O.L. Jr. "Learning About Time Zones in Grades Four, Five and Six," Journal of Experimental Education, XXXI (1963), pp. 407-412.

_____. et al. "The Usefulness of Time Lines in Learning Chronological Relationships in Text Materials," Journal of Experimental Education, XXXIV (Spring, 1966), pp. 22-25.

Dobbs, E.L. "A Study of the Sequential Development of Time Sense and Chronology in the Elementary School," Unpublished doctoral dissertation, University of Kansas, 1963.

Engel, A.M. and Baker, H.J. Detroit Beginning First-Grade Intelligence Test, Manual of Directions and Key. New York: World Book Company, 1937.

Farrell, M. "Understanding of Time Relations of Five-, Six-, and Seven-year-old Children of High I.Q.", Journal of Educational Research, XLVI (April, 1953), pp. 587-594.

Flavell, J.H. The Developmental Psychology of Jean Piaget. New York: Van Nostrand, 1965.

Flickenger, A. and Rehage, K.J. "Building Time and Place Concepts," Improving the Teaching of World History, Twentieth Yearbook, National Council for the Social Studies, Washington, D.C.: NCSS, 1949.

Friedman, K.C. "Time Concepts of Elementary School Children," Elementary School Journal, XLIV (February, 1944). pp. 337-342.

Gill, C.G. "Interpretations of Indefinite Expressions of Time," Social Education, XXVI (December, 1962), pp. 454-456.

Gulliksen, H. Theory of Mental Tests. New York: John Wiley and Sons, Inc., 1961.

Harrison, M.L. "The Nature and Development of Concepts of Time Among Young Children," Elementary School Journal, XXXIV (March, 1934), pp. 507-514.

Kelty, M.G. "Time Expressions Comprehended by Children of the Elementary School," Elementary School Journal, XXV (March, 1925), pp. 522-528., and XXV (April, 1925), pp. 607-618.

Lovell, K. and Slater, A. "The Growth of the Concept of Time: A Comparative Study," Journal of Child Psychology and Psychiatry and Allied Disciplines, I (December, 1960), pp. 159-162.

Mascho, G. "An Investigation of a Selected Number of Beginning First Grade Children's Familiarity with Measurement," Unpublished doctoral dissertation, University of Indiana, 1961.

McAulay, J.D. "What Understanding do Second Grade Children Have of Time Relationships?", Journal of Educational Research, LIV (1961), pp. 312-314.

Oakden, E.C. and Sturt, M. "The Development of the Knowledge of Time in Children," British Journal of Psychology, XII (1922), pp. 309-336.

Piaget, Jean. "The Development of Time Concepts in the Child," Psychopathology of Childhood, P.H.Hoch and J.Zubin, (eds.) New York: Grure and Stratton, 1955. pp. 34-44.

Pistor, F. "Measuring the Time Concepts of Children," Journal of Educational Research, XXXIII (December, 1939), pp. 293-300.

_____. "How Time Concepts are Acquired by Children," Educational Method, XX (1940), pp. 107-112.

Robison, H.F. and Spodek, B. New Directions in the Kindergarten, Early Childhood Education Series. Teachers' College Press: Teachers' College, Columbia University, New York, 1965.

Springer, D. "Development in Young Children of an Understanding of Time and the Clock," Pedagogical Seminary and Journal of Genetic Psychology, LXXX (1952), pp. 25-30.

Stephens, L.E. "What Concepts of Telling Time Can be Developed by Kindergarten Children?", Unpublished doctoral dissertation, University of California (Los Angeles), 1964.

Uka, N. "Sequence in the Development of Time Concepts in Children of Elementary School Age," Unpublished doctoral dissertation, University of Southern California, 1956.

Wesley, E.B. Teaching the Social Studies, Boston: Heath and Company, 1942.

APPENDIX A

A TEST OF COMPARISONS AND MEASURES OF DURATION

Subtest 1 - Verbal Comparisons of Duration

Item 1 — Which is longer, recess or lunch time?

Item 2 — Which is longer, the time from when you come into school in the morning until lunch time, or from lunch time to supper time?

Item 3 — Which is longer, the time you spend inside the school each day or the time you sleep at night?

Item 4 — My birthday is on the 1st of August. Which will come first, my next birthday or next Christmas?

Item 5 — Which is longer, the time since last Christmas or the time since last Halloween?

Item 6 — Which is longer, the time since you started grade --- (present grade) or the time since last Christmas?

Item 7 — Which will come first, next Halloween or next Christmas?

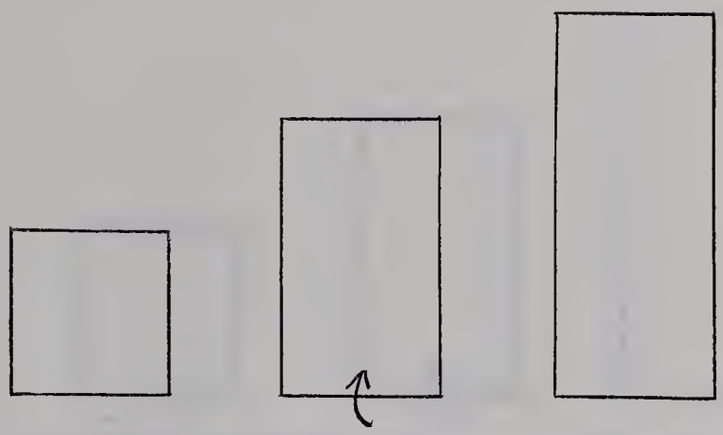
Item 8 — Which is longer, the summer holiday or the Christmas holiday?

Item 9 — Which is longer, the time since you started grade --- (present grade) until now, or from now until you start grade --- (next grade)?

Item 10 — Which is longer, the time between Halloween and Christmas or the time between Christmas and New Year?

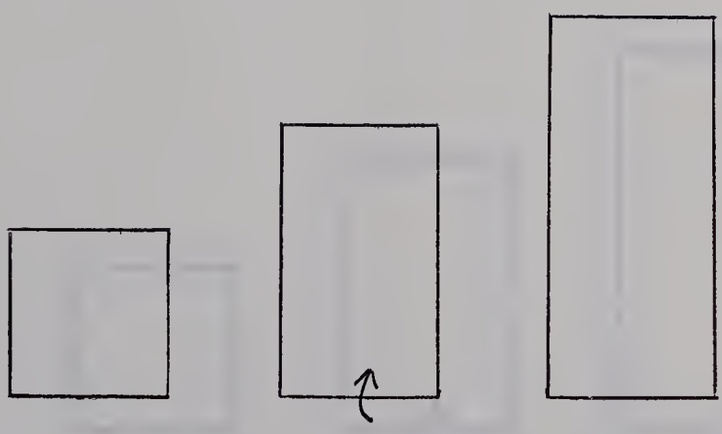
Subtest 2 - Graphic Comparisons of Duration

Item 1



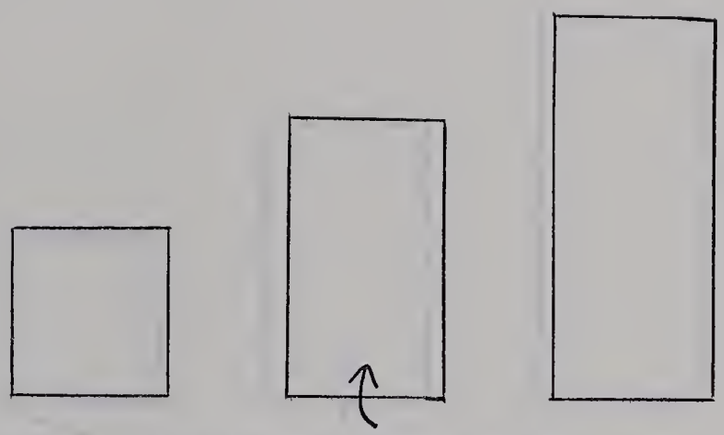
(Pointing) If this one shows you how long lunch time is, which one would show you how long recess is?

Item 2



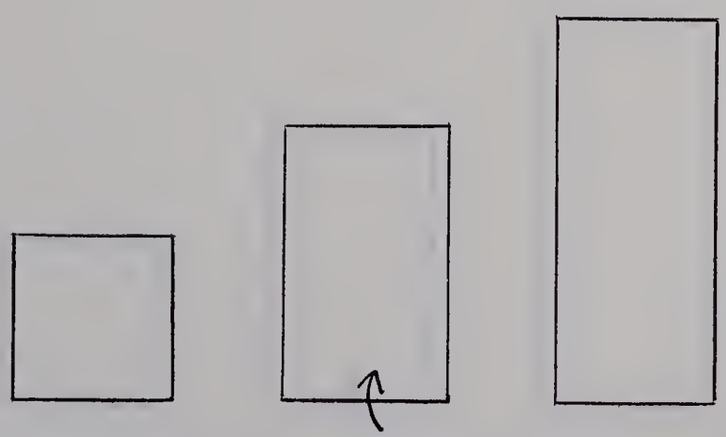
(Pointing) If this one shows you how long it is from when you come into school in the morning until lunch time, which one shows you how long it is from lunch time to supper time?

Item 3



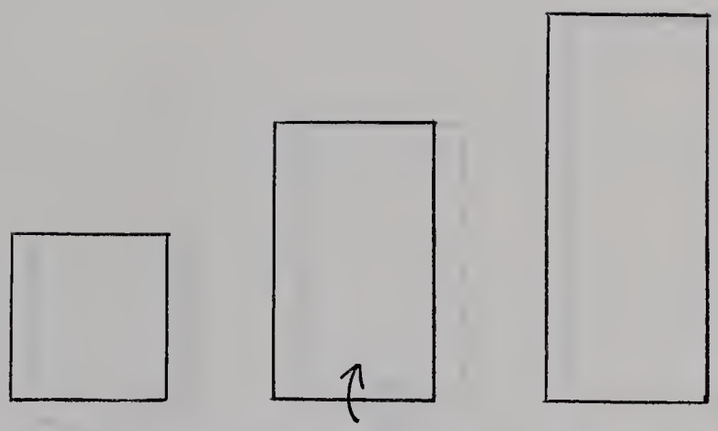
(Pointing) If this one shows you how long you sleep at night, which one shows you how long you spend inside the school each day?

Item 4



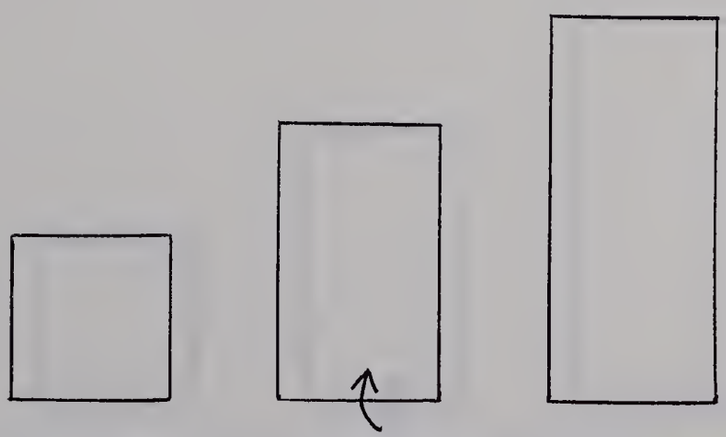
(Pointing) If this one shows you how long it is from now until Christmas, which one shows you how long it is from now until the First of August?

Item 5



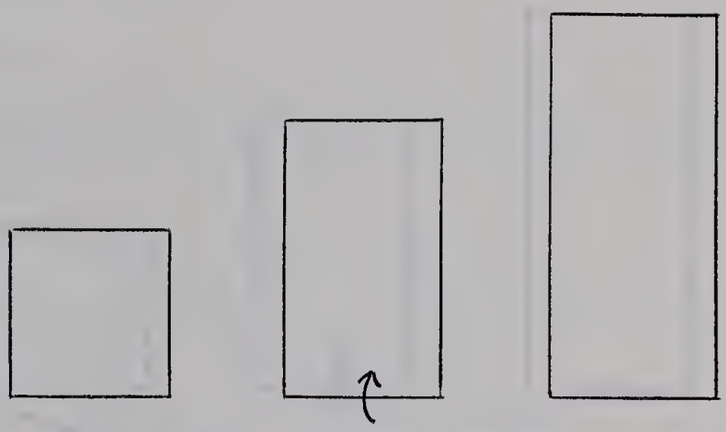
(Pointing) If this one shows you how long it is since last Christmas, which one shows you how long it is since last Halloween?

Item 6



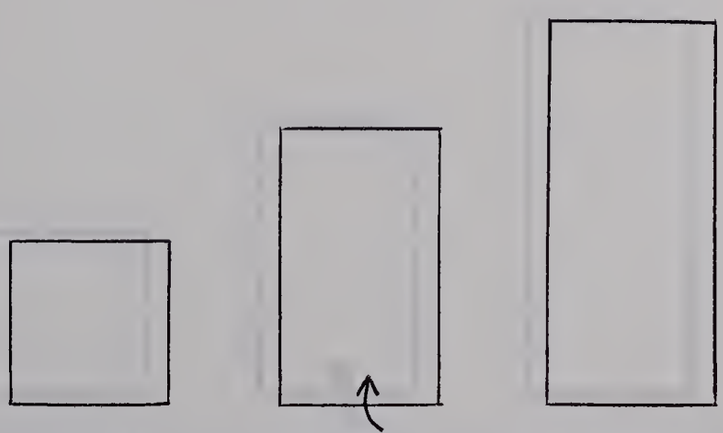
(Pointing) If this one shows you how long it is since you started grade --- (present grade), which one shows you how long it is since last Christmas?

Item 7



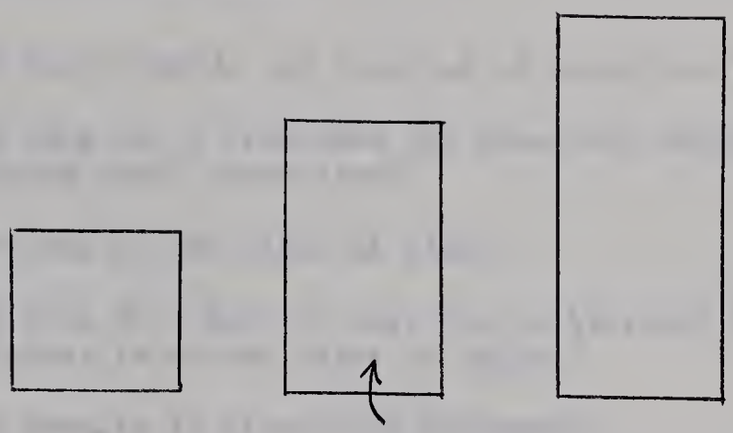
(Pointing) If this one shows you how long it is from now until next Halloween, which one shows you how long it is until next Christmas?

Item 8



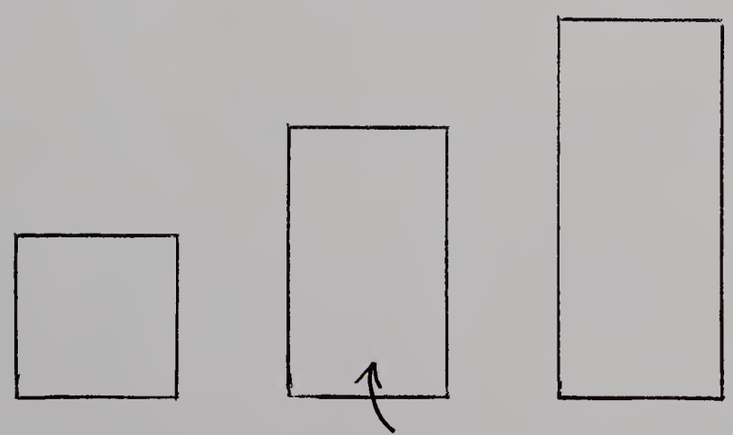
(Pointing) If this one shows you how long the summer holiday lasts, which one shows you how long the Christmas holiday lasts?

Item 9



(Pointing) If this one shows you how long it is since you started grade --- (present grade), which one shows you how long it will be until you start grade --- (next grade)?

Item 10



(Pointing) If this one shows you how long it is from Christmas to New Year, which one shows you how long it is from Halloween to Christmas?

Subtest 3 - Measures of Duration

Item 1	How much time do you have out of school at lunch time?
Item 2	How long is it from when you come into school in the morning until lunch time?
Item 3	How long do you sleep at night?
Item 4	How long do I have to wait for my birthday if my birthday is on the First of August?
Item 5	How long is it since last Christmas?
Item 6	How long is it since you started grade --- (present grade)?
Item 7	How long is it until next Christmas?
Item 8	How long is the summer holiday?
Item 9	How long will it be until you start grade --- (next grade)?
Item 10	How long is it between Christmas Day and New Years Day?

APPENDIX B

DATA COLLECTION SHEET

NAME: ---------- SCHOOL: ----------

I.D. ---------- SEX ----------

I.Q. ---------- GRADE ----------

BIRTHDAY ---------- AGE ----------

OCCUPATION ---------- S.E.S.R. ----------

Item	Test 1	Test 2	Test 3	0-1	0-1-2
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

COMPARISONS ----- GRAPHIC COMPARISONS ----- TOTAL COMPARISONS -----

MEASURES 1 ----- MEASURES 2 ----- COMBINED TOTAL -----

RESPONSES TO ITEMS OF SUBTEST 3

CONSIDERED BY THE EXAMINER TO BE PRECISE

Item Number	Precise Response
1	1½ hours
2	3 hours, $2\frac{3}{4}$ hours
3	8 to 12 hours
4	3 months, 3½ months
5	4 months
6	8 months, 7½ months
7	8 months, 7½ months
8	2 months,
9	4 months, 4½ months
10	1 week, 6 days

Note: Expression of these measures in alternative units was accepted. For instance, a response of 8 weeks was accepted for item 8.

RESPONSES TO ITEMS OF SUBTEST 3

CONSIDERED BY THE EXAMINER TO BE ACCEPTABLE

Item Number	Acceptable Response
1	1 hour, 1¼ hours, $1\frac{3}{4}$ hours
2	2½ hours, 2 hours, 4 hours
3	7 hours, 13 hours
4	2½ months, 2 months, 4 months
5	3 months, 3½ months, 4½ months
6	7 months, 9 months
7	7 months, 9 months
8	1½ months, 2½ months, 3 months
9	5 months, 3 months
10	less than 2 weeks, 8 days, 5 days

Note: Expression of these measures in alternative units was accepted. For instance, a response of 6 weeks was accepted for item 8.